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Ada COMPILER
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Certificate Number: 920509S1.11259
Alenia Aeritalia & Selenia S.p.A
DACS VAX/VMS to 80x86 PM MARA Ada Cross Compiler, Version 4.6
MicroVAX 4000/200 => MARA

Prepared By:
Software Standards Validation Group
National Computer Systems Laboratory
National Institute of Standards and Technology
Building 225, Room A266
Gaithersburg, Maryland 20899

AVF Control Number: NIST92ALE505_1_1.11

Certificate Information

The following Ada implementation was tested and determined to pass ACVC 1.11. Testing was completed on May 09, 1992.

Compiler Name and Version:	DACS VAX/VMS to 80x86 PM MARA Ada Cross Compiler, Version 4.6
Host Computer System:	MicroVAX 4000/200 running VAX/VMS, Version 5.4
Target Computer System:	MARA (Alenia computer based on INTEL 80286 running Alenia Operating System, Version 8.6 System)

See section 3.1 for any additional information about the testing environment.

As a result of this validation effort, Validation Certificate 920509S1.11259 is awarded to Alenia Aeritalia & Selenia S.p.A. This certificate expires on [the re-RE-revised Common Expiration Date: 2 years post ANSI/MIL-STD-1815B standardization].

This report has been reviewed and is approved.

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NIST92ALE505_1_1.11

DECLARATION OF CONFORMANCE

The following declaration of conformance was supplied by the customer.

Customer:	Alenia Aeritalia & Selenia S.p.A
Certificate Awardee:	Alenia Aeritalia & Selenia S.p.A
Ada Validation Facility:	National Institute of Standards and Technology Computer Systems Laboratory (CSL) Software Validation Group Building 225, Room A266 Gaithersburg, Maryland 20899
ACVC Version:	1.11

Ada Implementation:

Compiler Name and Version:	DACS VAX/VMS to 80x86 PM MARA Ada Cross Compiler, Version 4.6
Host Computer System:	MACROVAX 4000/200 running VAX/VMS, Version 5.4
Target Computer System:	MARA (Alenia computer based on INTEL 80286 running Alenia Operating System, Version 8.6 System)

Declaration:

I, the undersigned, declare that I have no knowledge of deliberate deviations from the Ada Language Standard ANSI/MIL-STD-1815A ISO 8652-1987 in the implementation listed above.

Customer Signature — Date: 8-5-92
Company Alenia Aeritalia & Selenia S.p.A
Title: Director

Certificate Awardee Signature — Date: 8-5-92
Company Alenia Aeritalia & Selenia S.p.A
Title: Director

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CHAPTER 1

INTRODUCTION

The Ada implementation described above was tested according to the Ada Validation Procedures [Pro90] against the Ada Standard [Ada83] using the current Ada Compiler Validation Capability (ACVC). This Validation Summary Report (VSR) gives an account of the testing of this Ada implementation. For any technical terms used in this report, the reader is referred to [Pro90]. A detailed description of the ACVC may be found in the current ACVC User's Guide [UG89].

1.1 USE OF THIS VALIDATION SUMMARY REPORT

Consistent with the national laws of the originating country, the Ada Certification Body may make full and free public disclosure of this report. In the United States, this is provided in accordance with the "Freedom of Information Act" (5 U.S.C. #552). The results of this validation apply only to the computers, operating systems, and compiler versions identified in this report.

The organizations represented on the signature page of this report do not represent or warrant that all statements set forth in this report are accurate and complete, or that the subject implementation has no nonconformities to the Ada Standard other than those presented. Copies of this report are available to the public from the AVF which performed this validation or from:

National Technical Information Service
5285 Port Royal Road
Springfield VA 22161

Questions regarding this report or the validation test results should be directed to the AVF which performed this validation or to:

Ada Validation Organization
Computer and Software Engineering Division
Institute for Defense Analyses
1801 North Beauregard Street
Alexandria VA 22311-1772

1.2 REFERENCES

[Ada83] Reference Manual for the Ada Programming Language, ANSI/MIL-STD-1815A, February 1983 and ISO 8652-1987.

[Pro90] Ada Compiler Validation Procedures, Version 2.1, Ada Joint Program Office, August 1990.

[UG89] Ada Compiler Validation Capability User's Guide, 21 June 1989.

1.3 ACVC TEST CLASSES

Compliance of Ada implementations is tested by means of the ACVC. The ACVC contains a collection of test programs structured into six test classes: A, B, C, D, E, and L. The first letter of a test name identifies the class to which it belongs. Class A, C, D, and E tests are executable. Class B and class L tests are expected to produce errors at compile time and link time, respectively.

The executable tests are written in a self-checking manner and produce a PASSED, FAILED, or NOT APPLICABLE message indicating the result when they are executed. Three Ada library units, the packages REPORT and SPPRT13, and the procedure CHECK_FILE are used for this purpose. The package REPORT also provides a set of identity functions used to defeat some compiler optimizations allowed by the Ada Standard that would circumvent a test objective. The package SPPRT13 is used by many tests for Chapter 13 of the Ada Standard. The procedure CHECK_FILE is used to check the contents of text files written by some of the Class C tests for Chapter 14 of the Ada Standard. The operation of REPORT and CHECK_FILE is checked by a set of executable tests. If these units are not operating correctly, validation testing is discontinued.

Class B tests check that a compiler detects illegal language usage. Class B tests are not executable. Each test in this class is compiled and the resulting compilation listing is examined to verify that all violations of the Ada Standard are detected. Some of the class B tests contain legal Ada code which must not be flagged illegal by the compiler. This behavior is also verified.

Class L tests check that an Ada implementation correctly detects violation of the Ada Standard involving multiple, separately compiled units. Errors are expected at link time, and execution is attempted.

In some tests of the ACVC, certain macro strings have to be replaced by implementation-specific values -- for example, the largest integer. A list of the values used for this implementation is provided in Appendix A. In addition to these anticipated test modifications, additional changes may be required to remove unforeseen conflicts between the tests and implementation-dependent characteristics. The modifications required for this implementation are described in section 2.3.

For each Ada implementation, a customized test suite is produced by the AVF. This customization consists of making the modifications described in the preceding paragraph, removing withdrawn tests (see section 2.1) and, possibly some inapplicable tests (see Section 3.2 and [UG89]).

In order to pass an ACVC an Ada implementation must process each test of the customized test suite according to the Ada Standard.

1.4 DEFINITION OF TERMS

Ada Compiler	The software and any needed hardware that have to be added to a given host and target computer system to allow transformation of Ada programs into executable form and execution thereof.
Ada Compiler Validation Capability (ACVC)	The means for testing compliance of Ada implementations, Validation consisting of the test suite, the support programs, the ACVC Capability user's guide and the template for the validation summary (ACVC) report.
Ada Implementation	An Ada compiler with its host computer system and its target computer system.
Ada Joint Program Office (AJPO)	The part of the certification body which provides policy and guidance for the Ada certification system.
Ada Validation Facility (AVF)	The part of the certification body which carries out the procedures required to establish the compliance of an Ada implementation.
Ada Validation Organization (AVO)	The part of the certification body that provides technical guidance for operations of the Ada certification system.
Compliance of an Ada Implementation	The ability of the implementation to pass an ACVC version.
Computer System	A functional unit, consisting of one or more computers and associated software, that uses common storage for all or part of a program and also for all or part of the data necessary for the execution of the program; executes user-written or user-designated programs; performs user-designated data manipulation, including

	arithmetic operations and logic operations; and that can execute programs that modify themselves during execution. A computer system may be a stand-alone unit or may consist of several inter-connected units.
Conformity	Fulfillment by a product, process or service of all requirements specified.
Customer	An individual or corporate entity who enters into an agreement with an AVF which specifies the terms and conditions for AVF services (of any kind) to be performed.
Declaration of Conformance	A formal statement from a customer assuring that conformity is realized or attainable on the Ada implementation for which validation status is realized.
Host Computer System	A computer system where Ada source programs are transformed into executable form.
Inapplicable test	A test that contains one or more test objectives found to be irrelevant for the given Ada implementation.
ISO	International Organization for Standardization.
LRM	The Ada standard, or Language Reference Manual, published as ANSI/MIL-STD-1815A-1983 and ISO 8652-1987. Citations from the LRM take the form "<section>.<subsection>:<paragraph>."
Operating System	Software that controls the execution of programs and that provides services such as resource allocation, scheduling, input/output control, and data management. Usually, operating systems are predominantly software, but partial or complete hardware implementations are possible.
Target Computer System	A computer system where the executable form of Ada programs are executed.
Validated Ada Compiler	The compiler of a validated Ada implementation.
Validated Ada Implementation	An Ada implementation that has been validated successfully either by AVF testing or by registration [Pro90].

Validation	The process of checking the conformity of an Ada compiler to the Ada programming language and of issuing a certificate for this implementation.
Withdrawn test	A test found to be incorrect and not used in conformity testing. A test may be incorrect because it has an invalid test objective, fails to meet its test objective, or contains erroneous or illegal use of the Ada programming language.

CHAPTER 2

IMPLEMENTATION DEPENDENCIES

2.1 WITHDRAWN TESTS

Some tests are withdrawn by the AVO from the ACVC because they do not conform to the Ada Standard. The following 95 tests had been withdrawn by the Ada Validation Organization (AVO) at the time of validation testing. The rationale for withdrawing each test is available from either the AVO or the AVF. The publication date for this list of withdrawn tests is 91-08-02.

E28005C	B28006C	C32203A	C34006D	C35508I	C35508J
C35508M	C35508N	C35702A	C35702B	B41308B	C43004A
C45114A	C45346A	C45612A	C45612B	C45612C	C45651A
C46022A	B49008A	B49008B	A74006A	C74308A	B83022B
B83022H	B83025B	B83025D	B83026B	C83026A	C83041A
B85001L	C86001F	C94021A	C97116A	C98003B	BA2011A
CB7001A	CB7001B	CB7004A	CC1223A	BC1226A	CC1226B
BC3009B	BD1B02B	BD1B06A	AD1B08A	BD2A02A	CD2A21E
CD2A23E	CD2A32A	CD2A41A	CD2A41E	CD2A87A	CD2B15C
BD3006A	BD4008A	CD4022A	CD4022D	CD4024B	CD4024C
CD4024D	CD4031A	CD4051D	CD5111A	CD7004C	ED7005D
CD7005E	AD7006A	CD7006E	AD7201A	AD7201E	CD7204B
AD7206A	BD8002A	BD8004C	CD9005A	CD9005B	CDA201E
CE2107I	CE2117A	CE2117B	CE2119B	CE2205B	CE2405A
CE3111C	CE3116A	CE3118A	CE3411B	CE3412B	CE3607B
CE3607C	CE3607D	CE3812A	CE3814A	CE3902B	

2.2 INAPPLICABLE TESTS

A test is inapplicable if it contains test objectives which are irrelevant for a given Ada implementation. The inapplicability criteria for some tests are explained in documents issued by ISO and the AJPO known as Ada Commentaries and commonly referenced in the format AI-ddddd. For this implementation, the following tests were determined to be inapplicable for the reasons indicated; references to Ada Commentaries are included as appropriate.

The following 201 tests have floating-point type declarations requiring more digits than SYSTEM.MAX_DIGITS:

C24113L..Y (14 tests)	C35705L..Y (14 tests)
C35706L..Y (14 tests)	C35707L..Y (14 tests)
C35708L..Y (14 tests)	C35802L..Z (15 tests)

C45241L..Y (14 tests)	C45321L..Y (14 tests)
C45421L..Y (14 tests)	C45521L..Z (15 tests)
C45524L..Z (15 tests)	C45621L..Z (15 tests)
C45641L..Y (14 tests)	C46012L..Z (15 tests)

C24113I..K (3 TESTS) use a line length in the input file which exceeds 126 characters.

C35404D, C45231D, B86001X, C86006E, and CD7101G check for a predefined integer type with a name other than INTEGER, LONG_INTEGER, or SHORT_INTEGER; for this implementation, there is no such type.

C35713B, C45423B, B86001T, and C86006H check for the predefined type SHORT_FLOAT; for this implementation, there is no such type.

C35713D and B86001Z check for a predefined floating-point type with a name other than FLOAT, LONG_FLOAT, or SHORT_FLOAT; for this implementation, there is no such type.

C45531M..P and C45532M..P (8 tests) check fixed-point operations for types that require a SYSTEM.MAX_MANTISSA of 47 or greater; for this implementation, MAX_MANTISSA is less than 47.

C45624A..B (2 tests) check that the proper exception is raised if MACHINE_OVERFLOWS is FALSE for floating point types and the results of various floating-point operations lie outside the range of the base type; for this implementation, MACHINE_OVERFLOWS is TRUE.

C4A013B contains a static universal real expression that exceeds the range of this implementation's largest floating-point type; this expression is rejected by the compiler.

D56001B uses 65 levels of block nesting; this level of block nesting exceeds the capacity of the compiler.

C96005B uses values of type DURATION's base type that are outside the range of type DURATION; for this implementation, the ranges are the same.

CA2009C and CA2009F check whether a generic unit can be instantiated before its body (and any of its subunits) is compiled; this implementation creates a dependence on generic units as allowed by AI-00408 and AI-00506 such that the compilation of the generic unit bodies makes the instantiating units obsolete. (See section 2.3.)

CD1009C checks whether a length clause can specify a non-default size for a floating-point type; this implementation does not support such sizes.

CD2A84A, CD2A84E, CD2A84I..J (2 tests), and CD2A84O use length clauses to specify non-default sizes for access types; this implementation does not support such sizes.

The 19 tests listed in the following table are not applicable because the given file operations are supported for the given combination of mode and file access method.

Test	File Operation	Mode	File Access Method
CE2102E	CREATE	OUT_FILE	SEQUENTIAL_IO
CE2102F	CREATE	INOUT_FILE	DIRECT_IO
CE2102J	CREATE	OUT_FILE	DIRECT_IO
CE2102N	OPEN	IN_FILE	SEQUENTIAL_IO
CE2102O	RESET	IN_FILE	SEQUENTIAL_IO
CE2102P	OPEN	OUT_FILE	SEQUENTIAL_IO
CE2102Q	RESET	OUT_FILE	SEQUENTIAL_IO
CE2102R	OPEN	INOUT_FILE	DIRECT_IO
CE2102S	RESET	INOUT_FILE	DIRECT_IO
CE2102T	OPEN	IN_FILE	DIRECT_IO
CE2102U	RESET	IN_FILE	DIRECT_IO
CE2102V	OPEN	OUT_FILE	DIRECT_IO
CE2102W	RESET	OUT_FILE	DIRECT_IO
CE3102F	RESET	Any Mode	TEXT_IO
CE3102G	DELETE	--------	TEXT_IO
CE3102I	CREATE	OUT_FILE	TEXT_IO
CE3102J	OPEN	IN_FILE	TEXT_IO
CE3102K	OPEN	OUT_FILE	TEXT_IO
CE3109A	CREATE	IN_FILE	TEXT_IO

The 2 tests listed in the following table check the given file operations for the given combination of mode and access method; this implementation does not support these operations.

Test	File Operation	Mode	File Access Method
CE2105A	CREATE	IN_FILE	SEQUENTIAL_IO
CE2105B	CREATE	IN_FILE	DIRECT_IO

The following 15 tests check operations on sequential, direct, and text files when multiple internal files are associated with the same external file; USE_ERROR is raised when this association is attempted.

CE2107A..B	CE2107E..G	CD2110B	CE2110D	CE2111D
CE2111H	CE3111A..B	CE3111D..E	CE3114B	CE3115A

CE2107C..D (2 tests), CE2107H, and CE2107L apply function NAME to temporary sequential, direct, and text files in an attempt to associate multiple internal files with the same external file; USE_ERROR is raised because temporary files have no name.

CE2108B, CE2108D, and CE3112B use the names of temporary sequential, direct, and text files that were created in other tests in order to check that the temporary files are not accessible after the completion of those tests; for this implementation, temporary files have no name.

CE2203A checks that WRITE raises USE_ERROR if the capacity of an external sequential file is exceeded; this implementation cannot restrict file capacity.

EE2401D uses an instantiation of DIRECT_IO with an unconstrained array type; for this implementation, the maximum element size of the array type exceeds the implementation limit of 32Kbytes and so USE_ERROR is raised.

CE2403A checks that WRITE raises USE_ERROR if the capacity of an external direct file is exceeded; this implementation cannot restrict file capacity.

CE3304A checks that SET_LINE_LENGTH and SET_PAGE_LENGTH raise USE_ERROR if they specify an inappropriate value for the external file; there are no inappropriate values for this implementation.

CE3413B checks that PAGE raises LAYOUT_ERROR when the value of the page number exceeds COUNT'LAST; for this implementation, the value of COUNT'LAST is greater than 150000, making the checking of this objective impractical.

2.3 TEST MODIFICATIONS

Modifications (see section 1.3) were required for 68 tests.

The following tests were split into two or more tests because this implementation did not report the violations of the Ada Standard in the way expected by the original tests.

B22003A	B26001A	B26002A	B26005A	B28003A	B29001A	B33301B
B35101A	B37106A	B37301B	B37302A	B38003A	B38003B	B38009A
B38009B	B55A01A	B61001C	B61001F	B61001H	B61001I	B61001M
B61001R	B61001W	B67001H	B83A07A	B83A07B	B83A07C	B83E01C
B83E01D	B83E01E	B85001D	B85008D	B91001A	B91002A	B91002B
B91002C	B91002D	B91002E	B91002F	B91002G	B91002H	B91002I
B91002J	B91002K	B91002L	B95030A	B95061A	B95061F	B95061G
B95077A	B97103E	B97104G	BA1001A	BA1101B	BC1109A	BC1109C
BC1109D	BC1202A	BC1202F	BC1202G	BE2210A	BE2413A	

C83030C and C86007A were graded passed by Test Modification as directed by the AVO. These tests were modified by inserting "PRAGMA ELABORATE (REPORT);" before the package declarations at lines 13 and 11, respectively. Without the pragma, the packages may be elaborated prior to package Report's body, and thus the packages' calls to function REPORT.IDENT_INT at lines 14 and 13, respectively, will raise PROGRAM_ERROR.

CA2009C and CA2009F were graded inapplicable by Evaluation Modification as directed by the AVO. These tests contain instantiations of a generic unit prior to the compilation of that unit's body; as allowed by AI-00408 and AI-00506, the compilation of the generic unit bodies makes the compilation unit that contains the instantiations obsolete.

BC3204C and BC3205D were graded passed by Processing Modification as directed by the AVO. These tests check that instantiations of generic units with unconstrained types as generic actual parameters are illegal if the generic bodies contain uses of the types that require a constraint. However, the generic bodies are compiled after the units that contain the instantiations, and this implementation creates a dependence of the instantiating units on the generic units as allowed by AI-00408 and AI-00506 such that the compilation of the generic bodies makes the instantiating units obsolete--no errors are detected. The processing of these tests was modified by re-compiling the obsolete units; all intended errors were then detected by the compiler.

CHAPTER 3

PROCESSING INFORMATION

3.1 TESTING ENVIRONMENT

The Ada implementation tested in this validation effort is described adequately by the information given in the initial pages of this report.

For technical information about this Ada implementation, contact:

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Testing of this Ada implementation was conducted at the customer's site by a validation team from the AVF.

3.2 SUMMARY OF TEST RESULTS

An Ada Implementation passes a given ACVC version if it processes each test of the customized test suite in accordance with the Ada Programming Language Standard, whether the test is applicable or inapplicable; otherwise, the Ada Implementation fails the ACVC [Pro90].

For all processed tests (inapplicable and applicable), a result was obtained that conforms to the Ada Programming Language Standard.

The list of items below gives the number of ACVC tests in various categories. All tests were processed, except those that were withdrawn because of test errors (item b; see section 2.1). All

tests passed, except those that are listed in sections 2.1 and 2.2 (counted in items b and f, below).

a)	Total Number of Applicable Tests	3792	
b)	Total Number of Withdrawn Tests	95	
c)	Processed Inapplicable Tests	283	
d)	Non-Processed I/O Tests	0	
e)	Non-Processed Floating-Point Precision Tests	0	
f)	Total Number of Inapplicable Tests	283	(c+d+e)
g)	Total Number of Tests for ACVC 1.11	4170	(a+b+f)

3.3 TEST EXECUTION

A magnetic tape containing the customized test suite (see section 1.3) was taken on-site by the validation team for processing. The contents of the magnetic tape were loaded directly onto the host computer.

After the test files were loaded onto the host computer, the full set of tests was processed by the Ada implementation.

Communications between the VAX, host computer system, and the MARA, target computer system, is done via Ethernet link using TCP/IP protocols, and two Alenia proprietary communications software programs: TOP and MJC. TOP is used to initialize the target. MJC is used to load the executable module(s) and to capture the execution results.

The tests were compiled and linked on the host computer system, as appropriate. The executable images were transferred to the target computer system by the communications link described above, and run. The results were captured on the host computer system.

Testing was performed using command scripts provided by the customer and reviewed by the validation team. See Appendix B for a complete listing of the processing options for this implementation. It also indicates the default options. The options invoked explicitly for validation testing during this test were:

For B tests, E tests, CZ, and not_applicable tests:
```
/LIST /NOSAVE_SOURCE
```

For all other tests:
```
/NOSAVE_SOURCE
```

Test output, compiler and linker listings, and job logs were captured on magnetic tape and archived at the AVF. The listings examined on-site by the validation team were also archived.

APPENDIX A

MACRO PARAMETERS

This appendix contains the macro parameters used for customizing the ACVC. The meaning and purpose of these parameters are explained in [UG89]. The parameter values are presented in two tables. The first table lists the values that are defined in terms of the maximum input-line length, which is the value for $MAX_IN_LEN--also listed here. These values are expressed here as Ada string aggregates, where "V" represents the maximum input-line length.

Macro Parameter	Macro Value
$MAX_IN_LEN	126 -- Value of V
$BIG_ID1	(1..V-1 => 'A', V => '1')
$BIG_ID2	(1..V-1 => 'A', V => '2')
$BIG_ID3	(1..V/2 => 'A') & '3' & (1..V-1-V/2 => 'A')
$BIG_ID4	(1..V/2 => 'A') & '4' & (1..V-1-V/2 => 'A')
$BIG_INT_LIT	(1..V-3 => '0') & "298"
$BIG_REAL_LIT	(1..V-5 => '0') & "690.0"
$BIG_STRING1	'"' & (1..V/2 => 'A') & '"'
$BIG_STRING2	'"' & (1..V-1-V/2 => 'A') & '1' & '"'
$BLANKS	(1..V-20 => ' ')
$MAX_LEN_INT_BASED_LITERAL	"2:" & (1..V-5 => '0') & "11:"
$MAX_LEN_REAL_BASED_LITERAL	"16:" & (1..V-7 => '0') & "F.E:"
$MAX_STRING_LITERAL	'"' & (1..V-2 => 'A') & '"'

The following table contains the values for the remaining macro parameters.

Macro Parameter	Macro Value
ACC_SIZE	32
ALIGNMENT	1
COUNT_LAST	2_147_483_647
DEFAULT_MEM_SIZE	1_048_576
DEFAULT_STOR_UNIT	16
DEFAULT_SYS_NAME	IAPX286
DELTA_DOC	2#1.0#E-31
ENTRY_ADDRESS	(140,0)
ENTRY_ADDRESS1	(141,0)
ENTRY_ADDRESS2	(142,0)
FIELD_LAST	67
FILE_TERMINATOR	ASCII.CR & ASCII.LF & ASCII.FF
FIXED_NAME	NO_SUCH_FIXED_TYPE
FLOAT_NAME	SHORT_SHORT_FLOAT
FORM_STRING	""
FORM_STRING2	"CANNOT_RESTRICT_FILE_CAPACITY"
GREATER_THAN_DURATION	75_000.0
GREATER_THAN_DURATION_BASE_LAST	131_073.0
GREATER_THAN_FLOAT_BASE_LAST	16#1.0#E+32
GREATER_THAN_FLOAT_SAFE_LARGE	16#5.FFFF_F0#E+31
GREATER_THAN_SHORT_FLOAT_SAFE_LARGE	1.0E308
HIGH_PRIORITY	7
ILLEGAL_EXTERNAL_FILE_NAME1	ILL-FILE
ILLEGAL_EXTERNAL_FILE_NAME2	THISFILENAMEISTOOLONGFORMYSYSTEM
INAPPROPRIATE_LINE_LENGTH	-1
INAPPROPRIATE_PAGE_LENGTH	-1
INCLUDE_PRAGMA1	PRAGMA INCLUDE ("A28006D1.TST")
INCLUDE_PRAGMA2	PRAGMA INCLUDE ("B28006E1.TST")
INTEGER_FIRST	-32768
INTEGER_LAST	32767
INTEGER_LAST_PLUS_1	32768
INTERFACE_LANGUAGE	ASM86
LESS_THAN_DURATION	-75_000.0
LESS_THAN_DURATION_BASE_FIRST	-131_073.0
LINE_TERMINATOR	ASCII.CR & ASCII.LF
LOW_PRIORITY	0
MACHINE_CODE_STATEMENT	MACHINE_INSTRUCTION'(NONE, m_RETN);
MACHINE_CODE_TYPE	REGISTER_TYPE

```
MANTISSA_DOC                    : 31
MAX_DIGITS                      : 15
MAX_INT                         : 2147483647
MAX_INT_PLUS_1                  : 2147483648
MIN_INT                         : -2147483648
NAME                            : NO_SUCH_TYPE_AVAILABLE
NAME_LIST                       : IAPX286
NAME_SPECIFICATION1             : :FMS:MARALAB/X2120A
NAME_SPECIFICATION2             : :FMS:MARALAB/X2120B
NAME_SPECIFICATION3             : :FMS:MARALAB/X3119A
NEG_BASED_INT                   : 16#FFFFFFFF#
NEW_MEM_SIZE                    : 1_048_576
NEW_STOR_UNIT                   : 16
NEW_SYS_NAME                    : IAPX286
PAGE_TERMINATOR                 : ASCII.FF
RECORD_DEFINITION               : RECORD NULL;END RECORD;
RECORD_NAME                     : NO_SUCH_MACHINE_CODE_TYPE
TASK_SIZE                       : 16
TASK_STORAGE_SIZE               : 1024
TICK                            : 0.000_000_125
VARIABLE_ADDRESS                : (16#0#,16#3C#)
VARIABLE_ADDRESS1               : (16#4#,16#3C#)
VARIABLE_ADDRESS2               : (16#8#, 16#3C#)
YOUR_PRAGMA                     : EXPORT_OBJECT
```

APPENDIX B

COMPILATION SYSTEM OPTIONS

The compiler options of this Ada implementation, as described in this Appendix, are provided by the customer. Unless specifically noted otherwise, references in this appendix are to compiler documentation and not to this report.

QUALIFIER	DESCRIPTION	REFERENCES
/AUTO_INLINE /NOAUTO_INLINE	Specifies whether local subprograms should be inline expanded.	5.1.1
/CHECK /NOCHECK	Controls run-time checks.	5.1.2
/CONFIGURATION_FILE	Specifies the configuration file used by the compiler.	5.1.3
/DEBUG /NODEBUG	Includes symbolic debugging information in program Library. Does not include symbolic information.	5.1.4
/EXCEPTION_TABLES /NOEXCEPTION_TABLES	Includes/excludes exception handler tables from the generated code.	5.1.15
/FIXPOINT_ROUNDING /NOFIXPOINT_ROUNDING	Generates fixed point rounding code. Avoids fixed point rounding code.	5.1.6
/FLOAT_ALLOWED /NOFLOAT_ALLOWED	Flags generation of float instructions as error if selected.	5.1.7
/LIBRARY	Specifies program library used.	5.1.8
/LIST /NOLIST	Writes a source listing on the list file.	5.1.9
/OPTIMIZE /NOOPTIMIZE	Specifies compiler optimization.	5.1.10
/PROGESS /NOPROGRESS	Displays compiler progress.	5.1.11

/SAVE_SOURCE **/NOSAVE_SOURCE**	Copies source to program library.	5.1.12
/TARGET_DEBUG **/NOTARGET_DEBUG**	Includes Intel debug information. Does not include Intel debug information.	5.1.5
/XREF **/NOXREF**	Creates a cross reference listing.	5.1.13
/UNIT	Assigns a specific unit number to the compilation (must be free and in a sublibrary).	5.1.14

LINKER OPTIONS

The linker options of this Ada implementation, as described in this Appendix, are provided by the customer. Unless specifically noted otherwise, references in this appendix are to linker documentation and not to this report.

Linker Configuration Qualifiers

QUALIFIER	DESCRIPTION	REFERENCE
/DEBUG /NODEBUG	Links an application for use with the Cross Debugger.	6.5.6
/LIBRARY	The library used in the link.	6.5.2
/LOG /NOLOG	Specifies creation of a log file.	6.5.4
/OPTIONS	Specifies target link options.	6.5.1
/SEARCHLIB	Target libraries or object modules to include in target link	6.1.4
/ROOT_EXTRACT /NOROOT_EXTRACT	Using non-DDC-I units in the root library	6.5.5
/SELECTIVE_LINK	Removes uncalled code from final program.	6.5.3
/STOP_BEFORE_LINK	Performs Ada prelink only.	6.1.5
/OFD=<object file directory>	Default may be set to the logical name "OFD:". The name of the directory to contain object files.	14.3
/AUTO_CLUSTER	Auto clusterization is active, if this qualifier is set.	14.3
/CLUSTER=<cluster file>	Takes cluster information from file specified.	14.3
/OPTIMIZE	Assures that intra-cluster CALLs are optimized. Far CALLs are substituted for PUSH CS, near CALL sequences. Returns remain far.	14.3

/PROCESSOR_ASS= <proc.assign_file>	Takes information about cluster position on processors into account, when elaborating.	14.3
/INTERFACED= <file>	The file or library specified will be added to the link command. An alternative to this qualifier is to use /SEARCHLIB (see above).	14.3
/RELINK= <relink_file>	The file is supposed to contain lines describing units that have been recompiled (under the same unit numbers).	14.3
/PRELINK	Activates Ada prelink.	APFX, Part II, 1.1.1
/LINK	Enables to obtain an executable program (.LTL) through a unique command in which appropriate qualifiers specify (see [User's Guide]) the parameters to be passed to the various tools involved in the generation.	APFX, Part II, 1.1.1
/TEMPLATE [= <identifier>]	Allows to specify which program architecture in the <graph> file specified by 'ada'_graph, is required to generate an executable program.	APFX, Part II, 1.1.2.1
/MAP /NOMAP (default)	It is necessary to create the map(<main>.MGA) of the program to be generated.	APFX, Part II, 1.1.2.2

Run-Time System Configuration Qualifiers

QUALIFIER	DESCRIPTION	REFERENCE
/LT_STACK_SIZE	Library task default stack size	7.2.4
/LT_SEGMENT_SIZE	Library task default segment size	7.2.5
/MP_STACK_SIZE	Main program stack size	7.2.6
/MP_SEGMENT_SIZE	Main program segment size	7.2.7
/PRIORITY	Default task priority	7.2.1
/TASK_STORAGE_SIZE	Tasks default storage size	7.2.8

APPENDIX C

APPENDIX F OF THE Ada STANDARD

The only allowed implementation dependencies correspond to implementation-dependent pragmas, to certain machine-dependent conventions as mentioned in Chapter 13 of the Ada Standard, and to certain allowed restrictions on representation clauses. The implementation-dependent characteristics of this Ada implementation, as described in this Appendix, are provided by the customer. Unless specifically noted otherwise, references in this Appendix are to compiler documentation and not to this report. Implementation-specific portions of the package STANDARD, which are not a part of Appendix F, are:

```
package STANDARD is

type SHORT_INTEGER is range -128 .. 127;

type INTEGER is range -32_768 .. 32_767;

type LONG_INTEGER is range  -2_147_483_648 .. 2_147_483_647;

type FLOAT is digits 6
    range -16#0.FFFF_FF#E32 .. 16#0.FFFF_FF#E32;

type LONG_FLOAT is digits 15
  range -16#0.FFFF_FFFF_FFFF_F8#E256 .. 16#0.FFFF_FFFF_FFFF_F8#E256;
type DURATION is delta 2#1.0#E-14 range -131_072.0 .. 131_071.0;

end STANDARD;
```

APPENDIX F IMPLEMENTATION-DEPENDENT CHARACTERISTICS

This appendix describes the implementation-dependent characteristics of DACS-80X86™ as required in Appendix F of the Ada Reference Manual (ANSI/MIL-STD-1815A).

A. Implementation-Dependent Pragmas

This section describes all implementation defined pragmas.

1. Pragma INTERFACE_SPELLING

This pragma allows an Ada program to call a non-Ada program whose name contains characters that are invalid in Ada subprogram identifiers. This pragma must be used in conjunction with pragma INTERFACE, i.e., pragma INTERFACE must be specified for the Ada subprogram name prior to using pragma INTERFACE_SPELLING.

The pragma has the format:

pragma INTERFACE_SPELLING (subprogram name, string literal);

where the subprogram name is that of one previously given in pragma INTERFACE and the string literal is the exact spelling of the interfaced subprogram in its native language. This pragma is only required when the subprogram name contains invalid characters for Ada identifiers.

Example:

```
function  RTS_GetDataSegment  return Integer;

pragma INTERFACE (ASM86, RTS_GetDataSegment);
pragma INTERFACE_SPELLING (RTS_GetDataSegment,
                           "R1SMGS?GetDataSegment");
```

The string literal may be appended 'NEAR (or 'FAR) to specify a particular method of call. The default is 'FAR. This suffix should only be used, when the called routines require a near call (writing 'FAR is however harmless). If 'NEAR is added, the routine must be in the same segment as the caller.

2. Pragma LT_SEGMENT_SIZE

This pragma sets the size of a library task stack segment.
The pragma has the format:

```
pragma LT_SEGMENT_SIZE (T, N);
```

where T denotes either a task object or task type and N designates the size of the library task stack segment in words.

The library task's stack segment defaults to the size of the library task stack. The size of the library task stack is normally specified via the representation clause (note that T must be a task type)

```
for T'STORAGE_SIZE use N;
```

The size of the library task stack segment determines how many tasks can be created which are nested within the library task. All tasks created within a library task will have their stacks allocated from the same segment as the library task stack. Thus, pragma LT_SEGMENT_SIZE must be specified to reserve space within the library task stack segment so that nested tasks' stacks may be allocated (see section ?).

The following restrictions are places on the use of LT_SEGMENT_SIZE:

1. It must be used only for library tasks.

2. It must be placed immediately after the task object or type name declaration.

3. The library task stack segment size (N) must be greater than or equal to the library task stack size.

3. Pragma EXTERNAL_NAME

a. Function

The pragma EXTERNAL_NAME is designed to make permanent Ada objects and subprograms externally available using names supplied by the user.

b. Format

The format of the pragma is:

pragma EXTERNAL_NAME(<ada_entity>,<external name>)

where <ada_entity> should be the name of:

- a permanent object, i.e. an object placed in the permanent pool of the compilation unit - such objects originate from package specifications and bodies only,

- a constant object, i.e. an object placed in the constant pool of the compilation unit - please note that scalar constants are embedded in the code, and composite constants are not always placed in the constant pool, because the constant is not considered constant by the compiler,

- a subprogram name, i.e. a name of a subprogram defined in this compilation unit - please notice that separate subprogram specifications cannot be used, the code for the subprogram must be present in the compilation unit code, and where the <external name> is a string specifying the external name associated the <ada_entity>. The <external names> should be unique. Specifying identical spellings for different <ada_entities> will generate errors at compile and/or link time, and the responsibility for this is left to the user. Also the user should avoid spellings similar to the spellings generated by the compiler, e.g. E_xxxxx_yyyyy, P_xxxxx, C_xxxxx and other internal identifications. The target debug type information associated with such external names is the null type.

c. Restrictions

Objects that are local variables to subprograms or blocks cannot have external names associated. The entity being made external ("public") must be defined in the compilation unit itself. Attempts to name entities from other compilation units will be rejected with a warning.

When an entity is an object the value associated with the symbol will be the relocatable address of the first byte assigned to the object.

d. Example

Consider the following package body fragment:

```
package body example is

    subtype string10 is string(1..10);

    type s is
       record
         len  : integer;
         val  : string10;
       end record;
```

```
        global_s  : s;
        const_s   : constant string10 := "1234567890";

        pragma EXTERNAL_NAME(global_s, "GLOBAL_S_OBJECT");
        pragma EXTERNAL_NAME(const_s,  "CONST_S");

        procedure handle(...) is
        ...
        end handle;

        pragma EXTERNAL_NAME(handle, "HANDLE_PROC");

        ...

end example;
```

The objects GLOBAL_S and CONST_S will have associated the names "GLOBAL_S_OBJECT" and "CONST_S". The procedure HANDLE is now also known as "HANDLE_PROC". It is allowable to assign more than one external name to an Ada entity.

e. Object Layouts

Scalar objects are laid out as described in Chapter 9. For arrays the object is described by the address of the first element; the array constraint(s) are NOT passed, and therefore it is recommended only to use arrays with known constraints. Non- discriminated records take a consecutive number of bytes, whereas discriminated records may contain pointers to the heap. Such complex objects should be made externally visible, only if the user has thorough knowledge about the layout.

f. Parameter Passing

The following section describes briefly the fundamentals regarding parameter passing in connection with Ada subprograms. For more detail, refer to Chapter 9.

Scalar objects are always passed by value. For OUT or IN OUT scalars, code is generated to move the modified scalar to its destination. In this case the stack space for parameters is not removed by the procedure itself, but by the caller.

Composite objects are passed by reference. Records are passed via the address of the first byte of the record. Constrained arrays are passed via the address of the first byte (plus a bitoffset when a packed array). Unconstrained arrays are passed as constrained arrays plus a pointer to the constraints for each index in the array. These constraints consist of lower and upper bounds, plus the size in words or bits of each element depending if the value is positive or negative respectively. The user should study an appropriate disassembler listing to thoroughly understand the compiler calling conventions.

A function (which can only have IN parameters) returns its result in register(s). Scalar results are registers/float registers only; composite results leave an address in some registers and the rest, if any, are placed on the stack top. The stack still contains the parameters in this case (since the function result is likely to be on the stack), so the caller must restore the stack pointer to a suitable value, when the function call is dealt with. Again, disassemblies may guide the user to see how a particular function call is to be handled.

B. Implementation-Dependent Attributes

No implementation-dependent attributes are defined.

C. Package SYSTEM

The specifications of package SYSTEM for all DACS-80x86 in Real Address Mode and DACS-80286PM systems are identical.

Below is package system for DACS-80x86.

```
package System is

   type     Word          is new Integer;
   type     DWord         is new Long_integer;

   type     UnsignedWord is range 0..65535;
   for      UnsignedWord'SIZE use 16;

   type     byte is range 0..255;
   for      byte'SIZE use 8;

   subtype SegmentId     is UnsignedWord;

   type     Address   is
      record
         offset  : UnsignedWord;
         segment : SegmentId;
      end record;

   subtype Priority  is Integer range 0..7;
   type Name      is (iAPX286);

   SYSTEM_NAME    : constant Name := iAPX286;
   STORAGE_UNIT   : constant      := 16;
   MEMORY_SIZE    : constant      := 1_048_576;
   MIN_INT        : constant      := -2_147_483_647-1;
   MAX_INT        : constant      := 2_147_483_647;
   MAX_DIGITS     : constant      := 15;
   MAX_MANTISSA   : constant      := 31;
   FINE_DELTA     : constant      := 2#1.0#E-31;
   TICK           : constant      := 0.000_000_125;
```

```
   type Interface_language is
                  (ASM86,     PLM86,     C86,     C86_REVERSE,
                   ASM_ACF,   PLM_ACF,   C_ACF,   C_REVERSE_ACF,
                   ASM_NOACF, PLM_NOACF, C_NOACF, C_REVERSE_NOACF);

   type ExceptionId  is record
                           unit_number   : UnsignedWord;
                           unique_number : UnsignedWord;
                        end record;

   type TaskValue      is new Integer;
   type AccTaskValue   is access TaskValue;
   type SemaphoreValue is new Integer;

   type Semaphore    is record
                           counter       : Integer;
                           first         : TaskValue;
                           last          : TaskValue;
                        end record;

   InitSemaphore : constant Semaphore := Semaphore'(1,0,0);
   foreign_exception : exception;
end System;
```

D. Representation Clauses

The DACS-80x86™ fully supports the 'SIZE representation for derived types. The representation clauses that are accepted for non-derived types are described in the following subsections.

1. Length Clause

Some remarks on implementation dependent behavior of length clauses are necessary:

- When using the SIZE attribute for discrete types, the maximum value that can be specified is 16 bits. For DACS-80386PM/80486PM the maximum is 32 bits.

- SIZE is only obeyed for discrete types when the type is a part of a composite object, e.g. arrays or records, for example:

```
type byte is range 0..255;
for byte'size use 8;

sixteen_bits_allocated : byte;                          -- one word allocated

eight_bit_per_element : array(0..7) of byte;     -- four words allocated
type rec is
   record
      c1,c2 : byte;                                     -- eight bits per component
   end record;
```

- Using the STORAGE_SIZE attribute for a collection will set an upper limit on the total size of objects allocated in this collection. If further allocation is attempted, the exception STORAGE_ERROR is raised.

- When STORAGE_SIZE is specified in a length clause for a task type, the process stack area will be of the specified size. The process stack area will be allocated inside the "standard" stack segment. Note that STORAGE_SIZE may not be specified for a task object.

2. Enumeration Representation Clauses

Enumeration representation clauses may specify representations in the range of -32767..+32766 (or -16#7FFF..16#7FFE).

3. Record Representation Clauses

When representation clauses are applied to records the following restrictions are imposed:

- if the component is a **record** or an **unpacked array**, it must start on a storage unit boundary (16 bits)

- a record occupies an integral number of storage units (words) (even though a record may have fields that only define an odd number of bytes)

- a record may take up a maximum of 32K bits

- a component must be specified with its proper size (in bits), regardless of whether the component is an array or not (Please note that record and unpacked array components take up a number of bits divisible by 16 (=word size))

- if a non-array component has a size which equals or exceeds one storage unit (16 bits) the component must start on a storage unit boundary, i.e. the component must be specified as:

```
component     at N range 0..16 * M - 1;
```

where N specifies the relative storage unit number (0,1,...) from the beginning of the record, and M the required number of storage units (1,2,...)

- the elements in an array component should always be wholly contained in one storage unit

- if a component has a size which is less than one storage unit, it must be wholly contained within a single storage unit:

```
component     at N range X .. Y;
```

where N is as in previous paragraph, and O <= X <= Y <= 15. Note that for this restriction a component is not required to start in an integral number of storage units from the beginning of the record.

If the record type contains components which are not covered by a component clause, they are allocated consecutively after the component with the value. Allocation of a record component without a component clause is always aligned on a storage unit boundary. Holes created because of component clauses are not otherwise utilized by the compiler.

Pragma pack on a record type will attempt to pack the components not already covered by a representation clause (perhaps none). This packing will begin with the small scalar components and larger components will follow in the order specified in the record. The packing begins at the first storage unit after the components with representation clauses.

a. Alignment Clauses

Alignment clauses for records are implemented with the following characteristics:

- If the declaration of the record type is done at the outermost level in a library package, any alignment is accepted.

- If the record declaration is done at a given static level higher than the outermost library level, i.e., the permanent area), only word alignments are accepted.

- Any record object declared at the outermost level in a library package will be aligned according to the alignment clause specified for the type. Record objects declared elsewhere can only be aligned on a word boundary. If the record type is associated with a different alignment, an error message will be issued.

- If a record type with an associated alignment clause is used in a composite type, the alignment is required to be one word; an error message is issued if this is not the case.

E. Implementation-Dependent Names for Implementation Dependent Components

None defined by the compiler.

F. Address Clauses

This section describes the implementation of address clauses and what types of entities may have their address specified by the user.

1. Objects

Address clauses are supported for scalar and composite objects whose size can be determined at compile time. The address clause may denote a dynamic value.

G. Unchecked Conversion

Unchecked conversion is only allowed between objects of the same "size". However, if scalar type has different sizes (packed and unpacked), unchecked conversion between such a type and another type is accepted if either the packed or the unpacked size fits the other type.

H. Machine Code Insertions

The reader should be familiar with the code generation strategy and the 80x86 instruction set to fully benefit from this section.

As described in chapter 13.8 of the ARM [DoD 83] it is possible to write procedures containing only code statements using the predefined package MACHINE_CODE. The package MACHINE_CODE defines the type MACHINE_INSTRUCTION which, used as a record aggregate, defines a machine code insertion. The following sections list the type MACHINE_INSTRUCTION and types on which it depends, give the restrictions, and show an example of how to use the package MACHINE_CODE.

1. Predefined Types for Machine Code Insertions

The following types are defined for use when making machine code insertions (their type declarations are given on the following pages):

```
type  opcode_type
type  operand_type
type  register_type
type  segment_register
```

type machine_instruction

The type REGISTER_TYPE defines registers. The registers STi describe registers on the floating stack. (ST is the top of the floating stack).

The type MACHINE_INSTRUCTION is a discriminant record type with which every kind of instruction can be described. Symbolic names may be used in the form

name'ADDRESS

Restrictions as to symbolic names can be found in section F.8.2.
It should be mentioned that addresses are specified as 80386/80486 addresses. In case of other targets, the scale factor should be set to "scale_1".

```
type opcode_type is (
            -- 8086 instructions:
        m_AAA,   m_AAD,   m_AAM,   m_AAS,   m_ADC,   m_ADD,   m_AND,   m_CALL,   m_CALLN,
        m_CBW,   m_CLC,   m_CLD,   m_CLI,   m_CMC,   m_CMP,   m_CMPS,  m_CWD,    m_DAA,
        m_DAS,   m_DEC,   m_DIV,   m_HLT,   m_IDIV,  m_IMUL,  m_IN,    m_INC,    m_INT,
        m_INTO,  m_IRET,  m_JA,    m_JAE,   m_JB,    m_JBE,   m_JC,    m_JCXZ,   m_JE,
        m_JG,    m_JGE,   m_JL,    m_JLE,   m_JNA,   m_JNAE,  m_JNB,   m_JNBE,   m_JNC,
        m_JNE,   m_JNG,   m_JNGE,  m_JNL,   m_JNLE,  m_JNO,   m_JNP,   m_JNS,    m_JNZ,
        m_JO,    m_JP,    m_JPE,   m_JPO,   m_JS,    m_JZ,    m_JMP,   m_LAHF,   m_LDS,
        m_LES,   m_LEA,   m_LOCK,  m_LODS,  m_LOOP,  m_LOOPE, m_LOOPNE,m_LOOPNZ,
        m_LOOPZ,m_MOV,    m_MOVS,  m_MUL,   m_NEG,   m_NOP,   m_NOT,   m_OR,     m_OUT,
        m_POP,   m_POPF,  m_PUSH,  m_PUSHF,m_RCL,   m_RCR,   m_ROL,   m_ROR,
        m_REP,   m_REPE,  m_REPNE,m_RET,   m_RETP,  m_RETN,  m_RETNP, m_SAHF,
        m_SAL,   m_SAR,   m_SHL,   m_SHR,   m_SBB,   m_SCAS,  m_STC,   m_STD,    m_STI,
        m_STOS,  m_SUB,   m_TEST,  m_WAIT,  m_XCHG,  m_XLAT,  m_XOR,

        -- 8087/80187/80287 Floating Point Processor instructions:

        m_FABS,    m_FADD,    m_FADDD,  m_FADDP,  m_FBLD,   m_FBSTP,   m_FCHS,
        m_FNCLEX,  m_FCOM,    m_FCOMD,  m_FCOMP,  m_FCOMPD, m_FCOMPP,  m_FDECSTP,
        m_FDIV,    m_FDIVD,   m_FDIVP,  m_FDIVR,  m_FDIVRD, m_FDIVRP,  m_FFREE,
        m_FIADD,   m_FIADDD,  m_FICOM,  m_FICOMD, m_FICOMP, m_FICOMPD, m_FIDIV,
        m_FIDIVD,  m_FIDIVR,  m_FIDIVRD,m_FILD,   m_FILDD,  m_FILDL,   m_FIMUL,
        m_FIMULD,  m_FINCSTP,m_FNINIT, m_FIST,   m_FISTD,  m_FISTP,   m_FISTPD,
        m_FISTPL,  m_FISUB,   m_FISUBD, m_FISUBR, m_FISUBRD,m_FLD,    m_FLDD,
        m_FLDCW,   m_FLDENV,  m_FLDLG2, m_FLDLN2, m_FLDL2E, m_FLDL2T, m_FLDPI,
        m_FLDZ,    m_FLD1,    m_FMUL,   m_FMULD,  m_FMULP,  m_FNOP,   m_FPATAN,
        m_FPREM,   m_FPTAN,   m_FRNDINT,m_FRSTOR, m_FSAVE,  m_FSCALE, m_FSETPM,
        m_FSQRT,   m_FST,     m_FSTD,   m_FSTCW,  m_FSTENV, m_FSTP,   m_FSTPD,
        m_FSTSW,   m_FSTSWAX,m_FSUB,   m_FSUBD,  m_FSUBP,  m_FSUBR,  m_FSUBRD,
        m_FSUBRP,  m_FTST,    m_FWAIT,  m_FXAM,   m_FXCH,   m_FXTRACT, m_FYL2X,
        m_FYL2XP1,m_F2XM1,

        -- 80186/80286/80386 instructions:
        -- Notice that some immediate versions of the 8086
        -- instructions only exist on these targets
        -- (shifts,rotates,push,imul,...)

        m_BOUND,   m_CLTS,    m_ENTER,  m_INS,    m_LAR,    m_LEAVE,  m_LGDT,
        m_LIDT,    m_LSL,     m_OUTS,   m_POPA,   m_PUSHA,  m_SGDT,   m_SIDT,
        m_ARPL,    m_LLDT,    m_LMSW,   m_LTR,

-- 16 bit always...

        m_SLDT,    m_SMSW,    m_STR,    m_VERR,   m_VERW,

        -- the 80386 specific instructions:

        m_SETA,    m_SETAE,   m_SETB,   m_SETBE,  m_SETC,   m_SETE,
        m_SETG,    m_SETGE,   m_SETL,   m_SETLE,  m_SETNA,  m_SETNAE,
        m_SETNB,   m_SETNBE,  m_SETNC,  m_SETNE,  m_SETNG,
        m_SETNGE,  m_SETNL,   m_SETNLE, m_SETNO,  m_SETNP,  m_SETNS,
```

```
        m_SETNZ,  m_SETO,    m_SETP,   m_SETPE,  m_SETPO,  m_SETS,
        m_SETZ,   m_BSF,     m_BSR,    m_BT,     m_BTC,    m_BTR,
        m_BTS,    m_LFS,     m_LGS,    m_LSS,    m_MOVZX,  m_MOVSX,
        m_MOVCR,  m_MOVDB,   m_MOVTR,  m_SHLD,   m_SHRD,

        -- the 80387 specific instructions:

        m_FUCOM,   m_FUCOMP,   m_FUCOMPP,   m_FPREM1,   m_FSIN,   m_FCOS,
        m_FSINCOS,

        -- byte/w      ord/dword variants (to be used, when
        -- not deductible from context):

        m_ADCB,   m_ADCW,   m_ADCD,   m_ADDB,   m_ADDW,   m_ADDD,
        m_ANDB,   m_ANDW,   m_ANDD,   m_BTW,    m_BTD,    m_BTCW,
        m_BTCD,   m_BTRW,   m_BTRD,   m_BTSW,   m_BTSD,   m_CBWW,
        m_CWDE,   m_CWDW,   m_CDQ,    m_CMPB,   m_CMPW,   m_CMPD,
        m_CMPSB,  m_CMPSW,  m_CMPSD,  m_DECB,   m_DECW,   m_DECD,
        m_DIVB,   m_DIVW,   m_DIVD,   m_IDIVB,  m_IDIVW,  m_IDIVD,
        m_IMULB,  m_IMULW,  m_IMULD,  m_INCB,   m_INCW,   m_INCD,
        m_INSB,   m_INSW,   m_INSD,   m_LODSB,  m_LODSW,  m_LODSD,
        m_MOVB,   m_MOVW,   m_MOVD,   m_MOVSB,  m_MOVSW,  m_MOVSD,
        m_MOVSXB, m_MOVSXW, m_MOVZXB, m_MOVZXW, m_MULB,   m_MULW,
        m_MULD,   m_NEGB,   m_NEGW,   m_NEGD,   m_NOTB,   m_NOTW,
        m_NOTD,   m_ORB,    m_ORW,    m_ORD,    m_OUTSB,  m_OUTSW,
        m_OUTSD,  m_POPW,   m_POPD,   m_PUSHW,  m_PUSHD,  m_RCLB,
        m_RCLW,   m_RCLD,   m_RCRB,   m_RCRW,   m_RCRD,   m_ROLB,
        m_ROLW,   m_ROLD,   m_RORB,   m_RORW,   m_RORD,   m_SALB,
        m_SALW,   m_SALD,   m_SARB,   m_SARW,   m_SARD,   m_SHLB,
        m_SHLW,   m_SHLDW,  m_SHRB,   m_SHRW,   m_SHRDW,  m_SBBB,
        m_SBBW,   m_SBBD,   m_SCASB,  m_SCASW,  m_SCASD,  m_STOSB,
        m_STOSW,  m_STOSD,  m_SUBB,   m_SUBW,   m_SUBD,   m_TESTB,
        m_TESTW,  m_TESTD,  m_XORB,   m_XORW,   m_XORD,   m_DATAB,
        m_DATAW,  m_DATAD,

        -- Special 'instructions':   m_label,   m_reset,

        -- 8087 temp real load/store_and_pop:   m_FLDT,   m_FSTPT);

pragma page;
        type operand_type is ( none, -- no operands

        immediate,              -- one immediate operand
        register,               -- one register operand
        address,                -- one address operand
        system_address,         -- one 'address operand
        name,                   -- CALL name
        register_immediate,     -- two operands :
                                        -- destination is
                                        -- register
                                        -- source is immediate
        register_register,      -- two register operands
        register_address,       -- two operands :
                                        -- destination is
                                        -- register
                                        -- source is address
        address_register,       -- two operands :
                                        -- destination is
                                        -- address
                                        -- source is register
        register_system_address,  -- two operands :
                                             -- destination is
                                             -- register
                                             -- source is 'address
        system_address_register,  -- two operands :
                                             -- destination is
                                             -- 'address
                                             -- source is register
        address_immediate,      -- two operands :
                                             -- destination is
                                             -- address
                                             -- source is immediate
        system_address_immediate, -- two operands :
                                             -- destination is
```

```
                                        -- 'address
                                        -- source is immediate
        immediate_register,    -- only allowed for OUT
                                        -- port is immediate
                                        -- source is register
        immediate_immediate,   -- only allowed for
                                        -- ENTER
        register_register_immediate, -- allowed for IMULimm,
                                        -- SHRDimm, SHLDimm
        register_address_immediate,  -- allowed for IMULimm
        register_system_address_immediate, -- allowed for IMULimm
        address_register_immediate,        -- allowed for SHRDimm,
                                                -- SHLDimm
        system_address_register_immediate  -- allowed for SHRDimm,
                                                -- SHLDimm
        );


type register_type is
   (AX, CX, DX, BX, SP, BP, SI, DI, -- word regs
    AL, CL, DL, BL, AH, CH, DH, BH, -- byte regs
    EAX,ECX,EDX,EBX,ESP,EBP,ESI,EDI,-- dword regs
    ES, CS, SS, DS, FS, GS,         -- selectors
    BX_SI, BX_DI, BP_SI, BP_DI,     -- 8086/80186/80286
                                    -- combinations
    ST,     ST1,    ST2,    ST3,    -- floating registers
                                    -- (stack)
    ST4,    ST5,    ST6,    ST7,
    nil);

    -- the extended registers (EAX .. EDI) plus FS and GS
    -- are only allowed in 80386 targets

type scale_type is (scale_1, scale_2, scale_4, scale_8);

subtype machine_string is string(1..100);

pragma page;
type machine_instruction (operand_kind : operand_type) is
   record
      opcode  : opcode_type;

      case operand_kind is
         when immediate =>
            immediate1 : integer;       -- immediate

         when register =>
            r_register : register_type;
            -- source and/or destination

         when address =>
            a_segment  : register_type;
            -- source and/or destination
            a_address_base      : register_type;
            a_address_index     : register_type;
            a_address_scale     : scale_type;
            a_address_offset    : integer;

         when system_address =>
            sa_address : system.address; -- destination

         when name =>
            n_string   : machine_string;  -- CALL destination

         when register_immediate =>
            r_i_register_to     : register_type;
            -- destination
            r_i_immediate       : integer;
           -- source

         when register_register =>
            r_r_register_to     : register_type;
            -- destination
            r_r_register_from   : register_type;
```

```
   -- source

when register_address =>
   r_a_register_to      : register_type;
   -- destination
   r_a_segment          : register_type;
   -- source
   r_a_address_base     : register_type;
   r_a_address_index    : register_type;
   r_a_address_scale    : scale_type;
   r_a_address_offset   : integer;

when address_register =>
   a_r_segment          : register_type;
   -- destination
   a_r_address_base     : register_type;
   a_r_address_index    : register_type;
   a_r_address_scale    : scale_type;
   a_r_address_offset   : integer;
   a_r_register_from    : register_type;
   -- source

when register_system_address =>
   r_sa_register_to     : register_type;
   -- destination
   r_sa_address         : system.address;
   -- source

when system_address_register =>
   sa_r_address         : system.address;
   -- destination
   sa_r_reg_from        : register_type;
   -- source

when address_immediate =>
   a_i_segment          : register_type;
   -- destination
   a_i_address_base     : register_type;
   a_i_address_index    : register_type;
   a_i_address_scale    : scale_type;
   a_i_address_offset   : integer;
   a_i_immediate        : integer;
   -- source

when system_address_immediate =>
   sa_i_address         : system.address;
   -- destination
   sa_i_immediate       : integer;
    -- source

when immediate_register =>
   i_r_immediate        : integer;
   -- destination
   i_r_register         : register_type;
   -- source

when immediate_immediate =>
   i_i_immediate1       : integer;
   -- immediate1
   i_i_immediate2       : integer;
   -- immediate2

when register_register_immediate =>
   r_r_i_register1      : register_type;
   -- destination
   r_r_i_register2      : register_type;
   -- source1
   r_r_i_immediate      : integer;
   -- source2

when register_address_immediate =>
   r_a_i_register       : register_type;
   -- destination
   r_a_i_segment        : register_type;
```

```
            -- source1
            r_a_i_address_base   : register_type;
            r_a_i_address_index  : register_type;
            r_a_i_address_scale  : scale_type;
            r_a_i_address_offset: integer;
            r_a_i_immediate      : integer;
            -- source2

         when register_system_address_immediate =>
            r_sa_i_register      : register_type;
            -- destination
            addr10               : system.address;
            -- source1
            r_sa_i_immediate     : integer;
            -- source2

         when address_register_immediate =>
            a_r_i_segment        : register_type;
            -- destination
            a_r_i_address_base   : register_type;
            a_r_i_address_index  : register_type;
            a_r_i_address_scale  : scale_type;
            a_r_i_address_offset: integer;
            a_r_i_register       : register_type;
            -- source1
            a_r_i_immediate      : integer;
            -- source2

         when system_address_register_immediate =>
            sa_r_i_address       : system.address;
            -- destination
            sa_r_i_register      : register_type;
            -- source1
            sa_r_i_immediate     : integer;
            -- source2

         when others =>
            null;
      end case;
   end record;

end machine_code;
```

2. Restrictions

Only procedures, and not functions, may contain machine code insertions.

Symbolic names in the form x'ADDRESS can only be used in the following cases:

1. x is an object of scalar type or access type declared as an object, a formal parameter, or by static renaming.

2. x is an array with static constraints declared as an object (not as a formal parameter or by renaming).

3. x is a record declared as an object (not a formal parameter or by renaming).

The m_CALL can be used with "name" to call (for) a routine.

Two opcodes to handle labels have been defined:

m_label: defines a label. The label number must be in the range 1 <= x <= 999 and is put in the offset field in the first operand of the MACHINE_INSTRUCTION.

m_reset: used to enable use of more than 999 labels. The label number after a m_RESET must be in the range 1<= x <= 999. To avoid errors you must make sure that all used labels have been defined before a reset, since the reset operation clears all used labels.

All floating instructions have at most one operand which can be any of the following:

- a memory address
- a register or an immediate value
- an entry in the floating stack

3. Examples

The following section contains examples of how to use the machine code insertions and lists the generated code.

4. Example Using Labels

The following assembler code can be described by machine code insertions as shown:

```
     MOV AX,7
     MOV CX,4
     CMP AX,CX
     JG  1
     JE  2
     MOV CX,AX
  1: ADD AX,CX
  2: MOV SS: [BP+DI], AX
```

```
package example_MC is

    procedure test_labels;
    pragma inline (test_labels);

end example_MC;

with MACHINE_CODE; use MACHINE_CODE;
package body example_MC is


procedure test_labels is

begin

  MACHINE_INSTRUCTION'(register_immediate, m_MOV, AX, 7);
  MACHINE_INSTRUCTION'(register_immediate, m_MOV, CX, 4);
  MACHINE_INSTRUCTION'(register_register,  m_CMP, AX, CX);
  MACHINE_INSTRUCTION'(immediate,          m_JG,  1);
  MACHINE_INSTRUCTION'(immediate,          m_JE,  2);
  MACHINE_INSTRUCTION'(register_register,  m_MOV, CX, AX);
  MACHINE_INSTRUCTION'(immediate,          m_label, 1);
  MACHINE_INSTRUCTION'(register_register,  m_ADD, AX, CX);
  MACHINE_INSTRUCTION'(immediate, m_label, 2);
  MACHINE_INSTRUCTION'(address_register,   m_MOV, SS, BP,
                                           DI, scale_1, 0, AX);
```

```
end test_labels;

end example_MC;
```

5. Advanced Topics

This section describes some of the more intricate details of the workings of the machine code insertion facility. Special attention is paid to the way the Ada objects are referenced in the machine code body, and various alternatives are shown.

a. Address Specifications

Package MACHINE_CODE provides two alternative ways of specifying an address for an instruction. The first way is referred to as SYSTEM_ADDRESS and the parameter associated this one must be specified via OBJECT'ADDRESS in the actual MACHINE_CODE insertion. The second way closely relates to the addressing which the 80x86 machines employ: an address has the general form

segment:[base+index*scale+offset]

The ADDRESS type expects the machine insertion to contain values for ALL these fields. The default value NIL for segment, base, and index may be selected (however, if base is NIL, so should index be). Scale MUST always be specified as scale_1, scale_2, scale_4, or scale_8. For 16 bit targets, scale_1 is the only legal scale choice. The offset value must be in the range of -32768 .. 32767.

b. Referencing Procedure Parameters

The parameters of the procedure that consists of machine code insertions may be referenced by the machine insertions using the SYSTEM_ADDRESS or ADDRESS formats explained above. However, there is a great difference in the way in which they may be specified; whether the procedure is specified as INLINE or not.

INLINE machine insertions can deal with the parameters (and other visible variables) using the SYSTEM_ADDRESS form. This will be dealt with correctly even if the actual values are constants. Using the ADDRESS form in this context will be the user's responsibility since the user obviously attempts to address using register values obtained via other machine insertions. It is in general not possible to load the address of a parameter because an 'address' is a two component structure (selector and offset), and the only instruction to load an immediate address is the LEA, which will only give the offset. If coding requires access to addresses like this, one cannot INLINE expand the machine insertions. Care should be taken with references to objects outside the current block since the code generator in order to calculate the proper frame value (using the display in each frame) will apply extra registers. The parameter addresses will, however, be calculated at the entry to the INLINE expanded routine to minimize this problem. INLINE expanded routines should NOT employ any RET instructions.

Pure procedure machine insertions need to know the layout of the parameters presented to, in this case, the called procedure. In particular, careful knowledge about the way parameters are passed is required to achieve a succesful machine procedure. Again there are two alternatives:

The first assumes that the user takes over the responsibility for parameter addressing. With this method, the SYSTEM_ADDRESS format does not make sense (since it expects a procedural setup that is not set up in a machine procedure). The user must code the exit from the procedure and is also responsible for taking off parameters if so is required. The rules of Ada procedure calls must be followed. The calling conventions are summarized below.

The second alternative assumes that a specific abstract A-code insertion is present in the beginning and end of the machine procedure. Abstract A-code insertions are not generally available to an Ada user since they require extensive knowledge about the compiler intermediate text called abstract A-code. Thus, they will not be explained further here except for the below use.

These insertions enable the user to setup the procedural frame as expected by Ada and then allow the form SYSTEM_ADDRESS in accesses to parameters and variables. Again it is required to know the calling conventions to some extent; mainly to the extent that the access method for variables is clear. A record is, for example, transferred via its address, so access to record fields must first employ an LES-instruction and then use ADDRESS form using the read registers.

The insertions to apply in the beginning are:

```
pragma abstract_acode_insertions(true);
 aa_instr'(aa_Create_Block,x,y,0,0,0);
 aa_instr'(aa_End_of_declpart,0,0,0,0,0);
pragma abstract_acode_insertions(false);
```

and at the end:

```
pragma abstract_acode_insertions(true);
 aa_instr'(aa_Exit_subprgrm,x,0,x,nil_arg,nil_arg); -- (1)
 aa_instr'(aa_Set_block_level,y-1,0,0,0,0);
pragma abstract_acode_insertions(false);
```

where the x value represents the number of words taken by the parameters, and y is the lexical block level of the machine procedure. However, if the procedure should leave the parameters on the stack (scalar IN OUT or OUT parameters), then the Exit_subprgrm insertion should read:

```
aa_instr'(aa_Exit_subprgrm,0,0,0,nil_arg,nil_arg); -- (2)
```

In this case, the caller moves the updated scalar values from the stack to their destinations after the call.

The NIL_ARG should be defined as :

```
nil_arg : constant := -32768;
```

WARNING: When using the AA_INSTR insertions, great care must be taken to assure that the x and y values are specified correctly. Failure to do this may lead to unpredictable crashes in compiler pass8.

c. Parameter Transfer

It may be a problem to figure out the correct number of words which the parameters take up on the stack (the x value). The following is a short description of the transfer method:

INTEGER types take up at least 1 storage unit. 32 bit integer types take up 2 words, and 64 bit integer types take up 4 words. In 32 bit targets, 16 bit integer types take up 2 words the low word being the value and the high word being an alignment word. TASKs are transferred as INTEGER.

ENUMERATION types take up as 16 bit INTEGER types (see above).

FLOAT types take up 2 words for 32 bit floats and 4 words for 64 bit floats.

ACCESS types are considered scalar values and consist of a 16 bit segment value and a 16 or 32 bit offset value. When 32 bit offset value, the segment value takes up 2 words the high word being the aligment word. The offset word(s) are the lowest, and the segment word(s) are the highest.

RECORD types are always transferred by address. A record is never a scalar value (so no post-procedure action is carried out when the record parameter is OUT or IN OUT). The representation is as for ACCESS types.

ARRAY values are transferred as one or two ACCESS values. If the array is constrained, only the array data address is transferred in the same manner as an ACCESS value. If the array is unconstrained below, the data address will be pushed by the address of the constraint. In this case, the two ACCESS values will NOT have any alignment words in 32 bit targets.

Packed ARRAY values (e.g. STRING types) are transferred as ARRAY values with the addition of an INTEGER bit offset as the highest word(s):

```
+H: BIT_OFFSET
+L: DATA_ADDRESS
+0: CONSTRAINT_ADDRESS      -- may be missing
```

The values L and H depend on the presence/absence of the constraint address and the sizes of constraint and data addresses.

In the two latter cases, the form parameter'address will always yield the address of the data. If access is required to constraint or bit offset, the instructions must use the ADDRESS form.

d. Example

A small example is shown below (16 bit target):

```
procedure unsigned_add

    (op1    : in    integer;
     op2            : in    integer;
     res            : out   integer);
```

Notice that machine subprograms cannot be functions.

The parameters take up:

op1	: integer	:	1 word
op2	: integer	:	1 word
res	: integer	:	1 word
Total	:		3 words

The body of the procedure might then be the following assuming that the procedure is defined at outermost package level:

```
procedure unsigned_add
              (op1   : in     integer;
               op2   : in     integer;
               res   :    out integer) is
begin
 pragma abstract_acode_insertions(true);
  aa_instr'(aa_Create_Block,3,1,0,0,0);  -- x = 3, y = 1
  aa_instr'(aa_End_of_declpart,0,0,0,0,0);
 pragma abstract_acode_insertions(false);

 machine_instruction'(register_system_address, m_MOV,
                      AX, op1'address);
 machine_instruction'(register_system_address, m_ADD,
                      AX, op2'address);
 machine_instruction'(immediate,                m_JNC,  1);
 machine_instruction'(immediate,                m_INT,  5);
 machine_instruction'(immediate,                m_label,1);
 machine_instruction'(system_address_register, m_MOV,
                      res'address, AX);

 pragma abstract_acode_insertions(true);
  aa_instr'(aa_Exit_subprgrm,0,0,0,nil_arg,nil_arg);-- (2)
  aa_instr'(aa_Set_block_level,0,0,0,0,0);       -- y-1 = 0
 pragma abstract_acode_insertions(false);
end unsigned_add;
```

A routine of this complexity is a candidate for INLINE expansion. In this case, no changes to the above 'machine_instruction' statements are required. Please notice that there is a difference between addressing record fields when the routine is INLINE and when it is not:

```
type rec is
  record
    low             : integer;
    high            : integer;
  end record;

procedure add_32 is
        (op1  : in integer;
         op2  : in integer;
         res            : out rec);
```

The parameters take up 1 + 1 + 2 words = 4 words. The RES parameter will be addressed directly when INLINE expanded, i.e. it is possible to write:

```
machine_instruction'(system_address_register, m_MOV,
                     res'address, AX);
```

This would, in the not INLINED version, be the same as updating that place on the stack where the address of RES is placed. In this case, the insertion must read:

```
machine_instruction'(register_system_address, m_LES,
                     SI, res'address);
   -- LES SI,[BP+...]
machine_instruction'(address_register, m_MOV,
                     ES, SI, nil, scale_1, 0, AX);
   -- MOV ES:[SI+0],AX
```

As may be seen, great care must be taken to ensure correct machine code insertions. A help could be to first write the routine in Ada, then disassemble to see the involved addressings, and finally write the machine procedure using the collected knowledge.

Please notice that INLINED machine insertions also generate code for the procedure itself. This code will be removed when the /NOCHECK qualifier is applied to the compilation. Also not INLINED procedures using the AA_INSTR insertion, which is explained above, will automatically get a storage_check call (as do all Ada subprograms). On top of that, 8 bytes are set aside in the created frame, which may freely be used by the routine as temporary space. The 8 bytes are located just below the display vector of the frame (from SP and up). The storage_check call will not be generated when the compiler is invoked with /NOCHECK.

The user also has the option NOT to create any blocks at all, but then he should be certain that the return from the routine is made in the proper way (use the RETP instruction (return and pop) or the RET). Again it will help first to do an Ada version and see what the compiler expects to be done.

Symbolic fixups are possible in certain instructions. With these you may build 'symbolic' instructions byte for byte. The instructions involved all require the operand type NAME (like used with CALL), and the interpretation is the following:

(name, m_DATAD, "MYNAME")	a full virtual address (offset and selector) of the symbol MYNAME (no additional offset is possible).
(name, m_DATAW, "MYNAME")	the offset part of the symbol MYNAME (no additional offset is possible).
(name, m_DATAB, "MYNAME")	the selector value of symbol MYNAME

In inlined machine instructions it may be a problem to obtain the address of a parameter (rather than the value). The LEA instruction may be used to get the offset part, but now the following form allows a way to load a selector value as well:

(system_address, LES, param'address)	ES is loaded with the selector of PARAM. If this selector was e.g. SS, it would be pushed and popped into ES. LES may be substituted for LFS and LGS for 80386.

APPENDIX F
PART II -

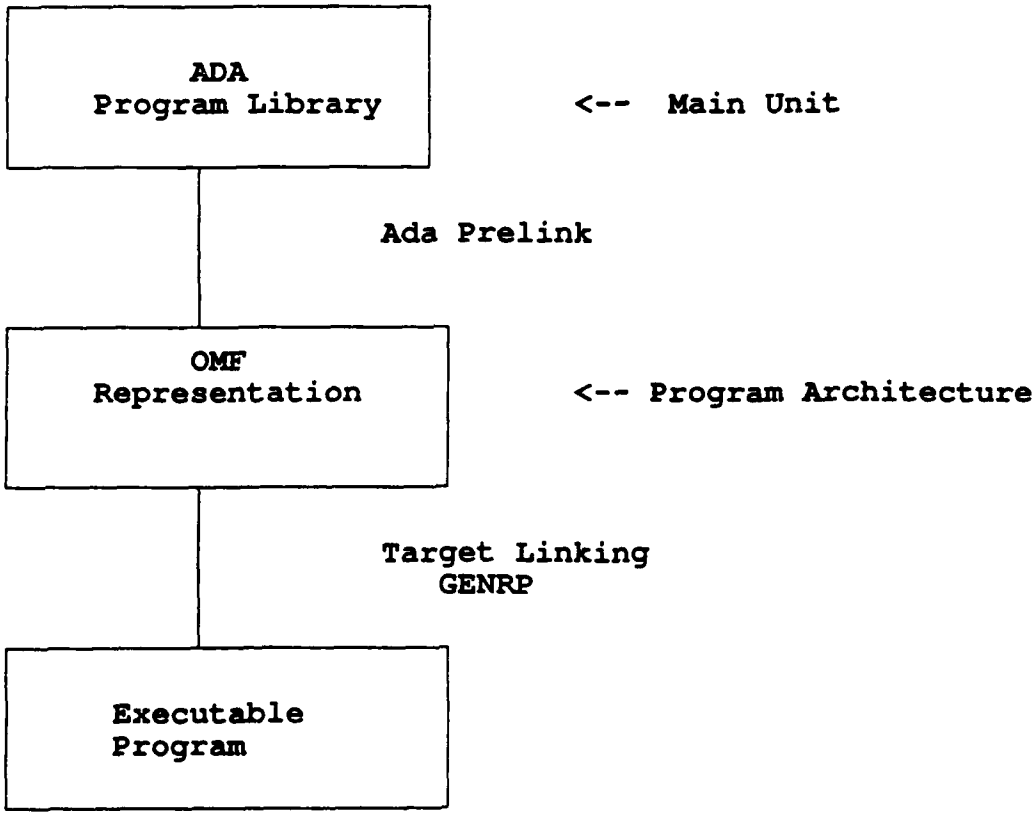
TARGET-DEPENDENT CHARACTERISTICS

1 Ada Linker - [LIN]

[User_Guide] lists the capabilities of Ada linker with respect to Ada programs programming aspects and to language definitions meaning. This section integrates DDC Ada Compiler System User Guide with respect to Ada linker use to generate Ada programs for Alenia computers. The reader is expected to be familiar with the terminology of Alenia computers Programming and Executing Environments ([SEL1 87], [SEL2 87]), as well as with Ada terminology ([LRM 83] and [User_guide]).

1.1 Linking Process

Ada linking process can be described as in the following figure.



Horizontal arrows represent inputs to linking process, while vertical arrows represent actions performed by the linker consequent on those inputs.

Two phases are identified in the linking process.

The former phase produces Ada program Intel Object Module Format (OMF) representation. One or more host files support such a representation. This is the collection of Ada compilation units selected by <main unit>program, and correspond to Ada program as in [LRM 83] chapter 10.

In the latter phase Alenia Software Factory works to integrate OMF Ada program with the piece of information to obtain an executable program for Alenia computer. All Ada Run Time Supports are introduced during this phase.

Ada Linker can be executed in two different modes, procedural and automatic.

Procedural mode consists in successive and explicit calls to the various tools necessary to generate the executable program.

Therefore, it provides call to Ada prelink, to linker target and to GENRP. Call to Ada prelink occurs through / PRELINK qualifier (par. 1.1.1).

The automatic condition to generate an executable program employs /LINK qualifier (par. 1.1.2) to activate automatically, in cascade, all tools
used.

Beside the qualifiers described in [User_Guide] and [CLU], the following qualifiers are allowed:

/PRELINK;
/LINK;
/TEMPLATE;
/MAP;
/DEBUG;

/PRELINK and /LINK accept all the qualifiers described in "ADA Compiler User Guide" Cap.6.

/LINK also accept /TEMPLATE, /MAP, /DEBUG.

1.1.1 /PRELINK qualifier -

/PRELINK qualifier , defined by installation ADA 'command verb', activates Ada prelink (it must be used in the place of /LINK

qualifier in [User_Guide] chap.6, therefore refer for use to such chapter).

To generate an Ada program obtained with the procedural mode, operations listed below must be implemented:

(be 'ada' the command verb used for Ada software factory installation in host environment;

be 'main' the Ada unit name compiled in 'Ada_library';

be 'graph.gra' the name of a graph;

be 'template' the name of a program architecture given in graph.gra)

1) - ada/prelink/library='ada_library'/ofd=[..] <main>

2) - @<main>_link

3) - genrp template,graph.gra

1) The command

ada/prelink/library='ada_library'/ofd=[] <main>

activates Ada prelink.

In input it takes:

- The current sublibrary which includes the compiled <main> unit

- Object File Directory name (OFD = [...])

- Main unit name

In output it produces:

- An assembler file called <main>_elab.asm which declares a procedure called CG?ADAMAINPROGRAM, that is also known as "anonymous task". It defines the processing order of main context (packages and subprogram of which a "with" clause has been done), and activates the main itself.

- A command file called <main>_LINK.COM which invokes the ASSEMBLER on <main>_elab.asm, generates a temporary file LINK.CTF which includes all object files that must be linked to the "main program" and invokes the BINDER286 by trasmitting to it in input, LINK.CTF file. BINDER286 output is a file whose name is the same as "main unit" name, and has .LNK extention,

2) The command

@<main>_LINK

executes <main>_LINK.COM file produced in the previous phase.

3) The command

GENRP 'template', 'graph.gra'

invokes GENRP [ref. MARA286 Computer Manual].

NOTE: If the files containing useful information for debugging (symbol file and map in Ada format) are to be produced, it is necessary:

- To define "MAPPER_LIBRARY" logic on "ADA_LIBRARY" (logic ex: DEFINE Mapper_library ada286_library).

- To specify ADAGEN in GENRP command (ex: GENRP 'template','graph.gra' ADAGEN)

Am example of the template to be used with the procedural mode follows.

• Example

Be MYPROC the name of Ada main unit.
Be MYPROC.LNK the name of the output file produced by LINK.COM.
An example of program template follows:

```
  system mysys;

  program template  mytemp large
              code  PRIVATE
              data  PRIVATE  NODAL;

  module  :FMS:ADARTSA1/RTSDATA.OBJ       relocatable;
  module  :FMS:ADABIOA1/BIODATA.OBJ       relocatable;
  module  MYPROC.LINK                     relocatable;
  module  :FMS:DACS86A0/ROOT.LIB          relocatable;
  module  :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module  :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module  :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module  :FMS:KER286A0/ADAUS.LIB         relocatable;
  module  GATELBA                         relocatable;

  initial procedure MYPROC
  stacksegment nodal size = 0FF00H;

end program;

hardware configuration;
volume    DEFAULT_VOLUME,
presence  NODAL origin FIRST_NODAL_PAGE
          LOCAL to 0 origin FIRST_LOCAL_PAGE;

end configuration;
```

```
include MYTEMP;
initial process on 0 priority 2;

end system;
```

1.1.2 LINK qualifier

/LINK qualifier , defined by installation ADA 'command verb', enables to obtain an executable program (.LTL) through a unique command in which appropriate qualifiers specify (see [User's Guide]) the parameters to be passed to the various tools involved in the generation.

An example of invocation of automatic linking process is given below:

```
  (be 'ada' the command verb used for Ada software
  factory installation in host environment;

  be 'main' the name of Ada unit compiled
  in ada_library;)
```

```
-   ada/link/library='ada_library'/ofd=[...] <main>
```

The command executes:

1) Ada prelink invocation
2) <main>_LINK.COM commands file execution
3) GENRP invocation

The command stresses GENRP with the following parameters:

- A default graph provided on installation is used as graph.
- From default graph is taken the template which has the same name as the graph, and it is used as template.

DEFAULT graph will be called 'ada'.gra where 'ada' is the installation "command verb".

The installation itself defines an 'ada'_graph logic on default graph.

Every user who needs particular and characteristic performances of its execution environment (which are not provided by the default graph), can define its own graph, but it must assign 'ada'_graph logic name to this graph.

Example:

1) $ define ada286_graph mygra.gra

2) $ ada286/link/ofd=[]/library=mylib.alb main

These commands implicitly define the following GENRP invocation:

$ GENRP mygra, mygra.gra

i.e., it is assumed that in mygra.gra graph, a template called mygra exists
[ref. par. 1.1.2.1.1 for additional information]

Default graph provides two program architectures relative to mono and multiprocessor generations.

The graph SCL description is reported below:

```
  system  <graph_name>;

  program template   <graph_name> large
              code  PRIVATE
              data  PRIVATE  NODAL;
  module  :FMS:ADARTSA1/RTSDATA.OBJ       relocatable;
  module  :FMS:ADABIOA1/BIODATA.OBJ       relocatable;
  module  <graph_name>                    relocatable;
  module  :FMS:DACS86A0/ROOT.LIB          relocatable;
  module  :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module  :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module  :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module  :FMS:KER286A0/ADAUS.LIB         relocatable;
  module  GATELBA                         relocatable;

  initial procedure cg_AdaMainProgram
  stacksegment nodal size = 0FF00H;

end program;
$ eject

  program template MULTI_<graph_name> large
              code PRIVATE
              data PRIVATE NODAL;

  Subprogram GENERAL Repeatable;
  module  :FMS:ADARTSA1/RTSDATA.OBJ       relocatable;
  module  :FMS:ADABIOA1/BIODATA.OBJ       relocatable;
  module  ELABORATION                     source asm;
  $include(Repeated)
  module  :FMS:DACS86A0/ROOT.LIB          relocatable;
  module  :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module  :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module  :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module  :FMS:KER286A0/ADAUS.LIB         relocatable;
  module  GATELBA                         relocatable;
```

```
   end subprogram;

 subprogram ZONE_0 optional;
$include(Zone0)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module  GATELBA                          relocatable;
 end subprogram;

 subprogram ZONE_1 optional;
$include(Zone1)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A1/ADAUS.LIB         relocatable;
  module  GATELBA                          relocatable;
 end subprogram;

 subprogram ZONE_7 optional;
$include(Zone7)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module  GATELBA                          relocatable;
 end subprogram;

 subprogram ZONE_8 optional;
$include(Zone8)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module  GATELBA                          relocatable;
 end subprogram;

 subprogram ZONE_9 optional;
$include(Zone9)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module  GATELBA                          relocatable;
 end subprogram;

 subprogram ZONE_10 optional;
$include(Zone10)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
```

```
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module   GATELBA                         relocatable;
 end subprogram;

 subprogram ZONE_11 optional;
$include(Zone11)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module   GATELBA                         relocatable;
 end subprogram;

 subprogram ZONE_12 optional;
$include(Zone12)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module   GATELBA                         relocatable;
 end subprogram;

 subprogram ZONE_13 optional;
$include(Zone13)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module   GATELBA                         relocatable;
 end subprogram;

 subprogram ZONE_14 optional;
$include(Zone14)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module   GATELBA                         relocatable;
 end subprogram;

 subprogram ZONE_15 optional;
$include(Zone15)
  module   :FMS:DACS86A0/ROOT.LIB          relocatable;
  module   :FMS:DACS86A0/RTHELP286.LIB     relocatable;
  module   :FMS:ADABIOA1/BINDER286.LIB     relocatable;
  module   :FMS:ADARTSA1/BINDER286.LIB     relocatable;
  module   :FMS:KER286A0/ADAUS.LIB         relocatable;
  module   GATELBA                         relocatable;
 end subprogram;
```

```
 initial procedure CG_AdaMainProgram
 stacksegment nodal size = 0ff00h;

 end program;
 hardware configuration;

     volume DEFAULT_VOLUME,
     presence    NODAL origin FIRST_NODAL_PAGE
  LOCAL to  0 origin FIRST_LOCAL_PAGE,
  LOCAL to  1 origin FIRST_LOCAL_PAGE,
  LOCAL to  2 origin FIRST_LOCAL_PAGE,
  LOCAL to  3 origin FIRST_LOCAL_PAGE,
  LOCAL to  4 origin FIRST_LOCAL_PAGE,
  LOCAL to  5 origin FIRST_LOCAL_PAGE,
  LOCAL to  6 origin FIRST_LOCAL_PAGE,
  LOCAL to  7 origin FIRST_LOCAL_PAGE,
  LOCAL to  8 origin FIRST_LOCAL_PAGE,
  LOCAL to  9 origin FIRST_LOCAL_PAGE,
  LOCAL to 10 origin FIRST_LOCAL_PAGE,
  LOCAL to 11 origin FIRST_LOCAL_PAGE,
  LOCAL to 12 origin FIRST_LOCAL_PAGE,
  LOCAL to 13 origin FIRST_LOCAL_PAGE,
  LOCAL to 14 origin FIRST_LOCAL_PAGE,
  LOCAL to 15 origin FIRST_LOCAL_PAGE;
   end configuration;

 include <graph_name>;
 initial process on 0 priority 2;

 include MULTI_<graph_name>;
$include(SubprogramAssign)
 initial process on 0 priority 2;

end system;
```

1.1.2.1 /TEMPLATE qualifier

<template> ::= /TEMPLATE [= <identifier>]

<template> allows to specify which program architecture in the <graph> file specified by 'ada'_graph, is required to generate an executable program.

The following policies apply when <template> is either missing or partially or totally specified.

a) if <template> is missing, then the following default is valid:
/template = <graph_name>

b) if only /template is specified, then the following default is valid:
/template = <main>

c) if /template = <name> is present, we assume that <name> is a program in the graph indicated by <'ada'_graph>

A GENRP error is reported when none of the above conditions can be matched.

For more details see Par. 1.1.2.1.1 and 1.1.3.

1.1.2.1.1 WRITING A PROGRAM TEMPLATE

Some precautions on writing a program template allows to make it "universal" i.e. it can be used with various Ada programs with no modifications.

In par. 1.1.1 an example of program template specialized in an Ada procedure called MYPROC has already been illustrated.

It is clear that he produced graph can be exclusively used with procedures which have the same name (MYPROC.LNK).

However, it is just by utilizing Ada linker structure that is possible to reach that program template "universality" of use mentioned above.

In order to reach this universality, it is necessary:

1) To assign tha same name to the template and to the main program included in it.

· Example:

```
Program template STANDARD LARGE

                  CODE PRIVATE
                  DATA PRIVATE NODAL

module :FMS:ADARTSA1/RTSDATA.OBJ relocatable;
module :FMS:ADABIOA1/BIODATA.OBJ relocatable;
module STANDARD
module :FMS:DACS86A0/ROOT.LIB          relocatable;
module :FMS:DACS86A0/RTHELP286.LIB     relocatable;
module :FMS:ADABIOA1/BINDER286.LIB     relocatable;
module :FMS:ADARTSA1/BINDER286.LIB     relocatable;
module :FMS:KER286A1/ADAUS.LIB         relocatable;
module GATELBA                         relocatable;
```

STANDARD is considered by Ada linker as a logic name assocoated to the last .LNK file produced.

2) To assign to initial procedure CG_ADAMAINPROGRAM name exported by Ada linker as entry point of the anonymous task.

· Example:

Initial procedure CG_ADAMAINPROGRAM
stack segment nodal size = 0FF00H

These two rules together with 'ada'_graph logic definition, and the automatic use of Ada linker [rif. 1.1.2] make very easy the generation of a relocatable program.

In addition, a graph construction will be done once at the beginning of an application design.

This will allow the user to focus more on those aspects of Ada language concerning its application.

1.1.2.2 /MAP qualifier

/NOMAP (default)

It is necessary to create the map (<main>.MGA) of the program to be generated.

As regards map format and further information, see Mapper Userguide [ADAMAP] and [GRP].

1.1.2.3 /DEBUG Qualifier -

/NODEBUG (default)

It is necessary for program debugging through IDA286 symbolic debugger.

The output produced consists of 2 files:

- <main>.SYM
- <main>.TLD

(see IDA286 User's Guide)

1.1.3 Example of Linker Use -

Generation of Ada programs on a monoprocessor.

Let's suppose that CATRIN.SCL contains the architectural description of our execution environment.

scl text:

```
system CATRIN;

        program template CATRIN  . . .
        end program;
        program template IPL_CATRIN . . .
        end program;
        program template TEST_PROGRAM . . .
            end program;
...

end system;
```

Be SOME_DIRECTORY the one in which CATRIN.GRA graph is produced.

Now let's assume that following Ada text refers to an Ada main program:

ada text:

```
    procedure TEST_PROGRAM is   . . .
    begin   . . .
    end;
```

It is necessary to define SOME_DIRECTORY:CATRIN.GRA as the user default graph: (ADA286 = Ada Command verb)

```
$ define ada286_graph some_directory:catrin.gra
```

Suppose that the linker invocation command for Ada TEST_PROGRAM procedural generation is the following:

```
ada286/prelink/ofd=[]/lib=.../template=CATRIN TEST_PROGRAM

@<main>_link

genrp CATRIN,ADA286_GRAPH
```

where CATRIN is the template used for the generation and CATRIN.GRA is the graph.file.

Linker invocation command for Ada TEST_PROGRAM automatic generation can be one of the following:

```
a) ada286/link/ofd=[]/lib=.../template=IPL_CATRIN TEST_PROGRAM

b) ada286/link/ofd=[]/lib=.../template TEST_PROGRAM

c) ada286/link/ofd=[]/lib=... TEST_PROGRAM
```

The following generation rules apply to a), b) and c) [ref. par. 1.1.2.1]:

a) IPL_CATRIN template of CATRIN_GRA is used for generation

b) TEST_PROGRAM template of CATRIN_GRA is used for generation

c) CATRIN_TEMPLATE of CATRIN_GRA is used for generation

2 ADA LIBRARY

The [User Guide] reports organization and supporting tools of the DDC 80x86 Cross Compiler System Program Library.

Here is the detailed structure of Ada program library delivered in DACS86 product. Ada specification and comments of the program units compiled in the Root Level Sublibrary are also included.

The root level of program library is subdued to configuration management, it owns a version and a release number. It is reserved for the compilation of general purpose services which range from language standard domain to implementation standard domain. Therefore, the user is strongly discouraged to compile in this sublibrary.

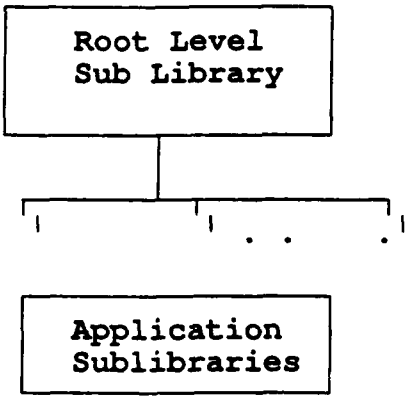
User compilations are recommended to introduce Program Units into the Program Library starting from a second level sublibrary. Refer to [User Guide] for details about sublibraries creation.

The first section reports the organization and the instruction for use of delivered program library.

The following two sections describe organization and contents, in terms of program units, of Ada Program Library delivered by the implementation.

2.1 Program library

The figure represents DACS 80x86 VAX/VMS crossed Ada Program Library delivered by the Implementation.



dacs86a0:dacs_system.alb
dacs86a0:root.lib

VAX/VMS files indicate the host files representing the sublibrary.

DACS86A0:DACS_SYSTEM.ALB collects all program units delivered (compiled) in the root sublibrary. To make the extraction of Ada application from the library more efficient, the corresponding object files are collected in Intel LIB286 library DACS86A0:ROOT.LIB, too. These two files are therefore strongly matched to each other, and the user should consider this kind of consistency when he decides to perform any compilation in root sublibrary. In chapter 7 of [User's Guide] can be found instructions necessary to update DACS86A0:ROOT.LIB file when new compilations are added to the root.

2.2 Root Sublibrary Content

Root Level Sublibrary exports services defined by the predefined language packages and subprograms, as indicated in package STANDARD declaration (cfr. [LRM] Appendix C). Specifications and relative items depending on the implementation can be found in Appendix F of [User_Guide].

This section also introduces the user to Ada supports defined to access to the capabilities of Alenia computers architectural components, both hardware and software.

Most of the above components present an environmental interface, which is a library,may be generic, package specification. This means that an application program can use them through the context clause, as illustrated in the following example.

Example:

```
with <some_architectural_components> ;
procedure <some_application> is ... end;
```

In the library are delivered some packages necessary to support the Cross Compiler and the Run Time Support.

3 MULTIPROCESSOR PROGRAM GENERATION - [MPG]

Ada toolset supports multiprocessor target architectures, allowing the code distribution to private memories of various processors, and the possibility at run Time - through a particular package - to fix the processor which must perform a particular task (ref. ADA RTS package in [APP B]).

The user who prepares to implement a multiprocessor Ada program must assure the physical addressability of objects and agents which, though Ada visible, may be not physically visible, as they are wrongly assigned in node memory.

Examples:

- Code addressability

```
package body P1 is
...
...
        X:integer
        procedure SOME_PROCEDURE(Y:in integer) is separate;
...
...
    begin
        ...
        ...
        SOME_PROCEDURE(X)
        ...
        ...
    end;
```

In order to allow the processing of this Ada text, SOME_PROCEDURE compilation unit must have been allocated on the same processor which is processing the P1 compilation unit.

- Data addressability

```
package SHARED is
        VAR_COM: integer := 0;
end SHARED;
package body SHARED is . . .
end SHARED;

with SHARED;
package TASKDEF is
```

```
            task type T is
                entry E;
            end T;

    end TASKDEF;
    package body TASKDEF is
            task body T is
            begin
                accept E do
                    SHARED.VAR_COM = SHARED.VAR_COM + 1;
                end;
            end T;

    begin . . .
    end TASKDEF;
```

Each EXAMPLE_A, EXAMPLE_B and EXAMPLE_C compilation units include a procedure declaration which, in turn, allocates a T object.

```
C.U.        : EXAMPLE_A
                with TASKDEF; use TASKDEF;
                procedure EXAMPLE_A is
                        TASK_A: T;
                          ..
                          ..
                begin
                          ..
                          ..
                end EXAMPLE_A;

C.U.        : EXAMPLE_B
              with TASKDEF; use TASKDEF;
              procedure EXAMPLE_B is
                          TASK_B: T;
                        ..
                        ..
              begin
                        ..
                        ..
              end EXAMPLE_B;

C.U.        : EXAMPLE_C
              with TASKDEF; use TASKDEF;
              procedure EXAMPLE_C is
                          TASK_C: T;
                        ..
                        ..
              begin
                        ..
                        ..
              end EXAMPLE_C;
```

In case EXAMPLE_A, EXAMPLE_B, and EXAMPLE_C procedures are allocated on different processors, their invocation causes the

activation of tasks of T Type on these processors and the need to access to the VAR_COM shared variable (ref. [LRM] 9.14). This requires a nodal allocation of this variable, in order to make it actually addressable from each task.

Therefore, in order to meet addressability constraints, in relation to code segments, the system designer must be sure that each local area include, within it, the whole compilation unit code imported in this area.

This result can be obtained either by allocating the code - referred from various areas - in the nodal memory, or by repeating this code in local memories of involved processors.

Nodal memory use is absolutely necessary when it is a matter of assuring the addressability of data shared by various tasks on various processors.

Code repetition is advisable in order to assure shared code addressability.

3.1 Cluster

SCL configuration language allows the arrangement of a program in subprograms, which make up the allocation unit within the node. Each subprogram, in turn, is composed of one or more relocatable or source format modules.

Particular remarks must be made when Ada language is used.

In fact, this language has a specific tool, the Ada Pre-Linker, which can collect - from the program library - compilation units referred by the main procedure of a particular Ada program. Yet, Ada Pre-linker assures that the processing order (see [LRM ch. 10]) of library units referred by the program is respected, by sequencing its processing in <main>_ELAB.ASM module. In a multiprocessor context, not all library units are local to the processor which starts the whole program processing. Thus, the migration of program processing is needed when - consistently with the fixed order - the elaboration of units allocated to a processor, different from the current one, is required.

Ada Pre-linker must be informed of what library units have to be processed by what processors, so that these migrations correctly occur.

This piece of information is given in terms of compilation units groups known as CLUSTERS, and to what processors they are allocated. For this purpose, Ada Pre-linker makes available two qualifiers of the command line: /CLUSTER and /PROCESSOR_ASSIGNMENT (see [CLU]).

Cluster is a collection of compilation units correlated to one another by a logic defined by the user. They represent the allocation unit on a memory area, and as such, they provide the

means to organize an Ada Program in components which - potentially - can be allocated in different memory areas.

3.2 Clusters Definition Criteria

This paragraph is aimed to list a series of criteria in order to define the clusters of a specific program which must be processed in a multiprocessor context.

These criteria have an impact on the architectural structure of a multiprocessor program text, implying the need to compile separately the program units which are to be allocated in any cluster. In a monoprocessor context, program units separate compilation is due essentially to reasons relating to software engineering.

In a multiprocessor program design, the identification of those program fragments which must be allocated in different processors becomes particularly important. This either in order to better program performances, or to use particular hardware supports locally connected to these processors.

This identification process is expressed in terms of compilation units grouped in clusters which collect, as mentioned above, the units of allocation to the different processors which are to be involved in the processing.

Thus, the distribution criterium in a multiprocessor hardware context is the leading criterium to clusters definition. We indicate this type of cluster with the term: POLO.

Unlike [SCL] SUBPROGRAMS, clusters are limited by a memory segment physical size. So, for a particular processor, the additional definition of extension clusters can be needed.

Thus, a particular cluster size, in terms of code, can justify additional clusters definition in relation to program poles. We define this type of cluster with the term: GREGARIUS.

Clusters identified by previous criteria, may have non null intersections at the level of the compilation units needed by various processors. It is possible to perform a processor local repetition of these compilation units code without modifying the program logic. However, in order to make this possible, the definition of new clusters with these units is needed to control their repetition.

Thus, the intersection of the poles and relative gregariuses, justifies new clusters introduction. The following term indicates this type of cluster: REPEATER.

The last criterium which can justify the definition of clusters, is the need to put in the same physical memory segment two or more compilation units which often are called. This minimizes the number of run time switchings of code segments in the CS machine register (call NEAR).

Procedural calls efficiency justifies new clusters introduction, or processor clustering reorganization.
We indicate this type of cluster with the term: FAMILY

Besides the justifications already mentioned, there are not other reasons which justify new clusters declaration. This does not mean that these criteria allow the clustering of all compilation units of a program. Rather often the programmer can express for some of them no clusterization of those listed above. Tipically, these units lie outside the programmer direct control and are imported in the application by dependence relationships transitively expressed by context clauses.

For these units, a total repetition on all processors involved in the application processing is required. As the support description will show, the user has not to express explicitly this requirement as the tool can define - on its own - an adequate number of clusters that, however, will be shared out to all processors.

3.3 SCL Description

Likewise the default architecture for monoprocessor generations, SCL description of multiprocessor generations architecture is the framework of a programs family. Family programs differ in their contents, and for the allocation of 16 optional subprograms, and of a repeatable subprogram.

Subprograms contents parametrization is expressed by using the SCL "$INCLUDE" directive of a file which lists the compilation units allocated to the relative processor.

Subprograms allocation parametrization is expressed by using the SCL "$INCLUDE" directive of the file of allocation of non empty subprograms to required processors.

A SCL scheme of a multiprocessor program generic architecture is reported below.

```
system <system_name>;

program template <template_name> large
          <default_code_protection>
          <default_data_protection_and_allocation>;

          <repeatable_subprogram_declaration>;
          { <optional_subprogram_declaration> } 0..15;

  initial procedure <template_name>
              <stack_segment_size_and_allocation>;

end program;

hardware configuration;
      <volume_declaration>
```

```
      <nodal_zone_declaration>
      { <local_zone_declaration> } 0..15
end configuration;
[ <program_activation> ]

end system;

<repeatable_subprogram_declaration> ::=
          subprogram GENERAL repeatable;
          module  :FMS:ADARTSA1/RTSDATA.OBJ       relocatable;
          module  :FMS:ADABIOA1/BIODATA.OBJ       relocatable;
          module  :FMS:ELABORATION                source asm;
          <repeated_list>;
          { <module> };
          module      :FMS:DACS86A0/ROOT.LIB      relocatable;
          module      :FMS:DACS86A0/RTHELP286.LIBrelocatable;
          module      :FMS:ADABIOA1/BINDER286.LIB relocatable;
          module      :FMS:ADARTSA1/BINDER286.LIBrelocatable;
          module      :FMS:KER286A0/ADAUS.LIB         relocatable
          module      GATELBA                     relocatable;
      end subprogram;

<optional_subprogram_declaration> ::=
      subprogram ZONE_<i> optional;
<zone_list>;
{ <module> };
          module      :FMS:DACS86A0/ROOT.LIB      relocatable;
          module      :FMS:DACS86A0/RTHELP286.LIBrelocatable;
          module      :FMS:ADABIOA1/BINDER286.LIB relocatable;
          module      :FMS:ADARTSA1/BINDER286.LIB relocatable;
          module      :FMS:KER286A0/ADAUS.LIB     relocatable;
          module      GATELBA                     relocatable;
      end subprogram;

<repeated_list>   ::= $ INCLUDE (REPEATED)
<zone_list>       ::= $ INCLUDE ( ZONE_<zone_identifier> )
<zone_identifier>     ::= 0 | 1 | 2 | . . . | 15

<program_activation>  ::=
                          <activation_modality>
                          <allocation_directive>
                          <initial_process_declaration>
<activation_modality>     ::=  include <template_name>;
                             | invoke <template_name>;

<allocation_directive>    ::= $ INCLUDE (SUBPROGRAMASSIGN);
```

"$ INCLUDE" directives must be placed in column 1.

"INVOKE" activation specifications require a function declaration which includes their declarative (see [SCL]).

"Repeatable" subprogram contains the common utility code (for instance the libraries which allow Ada program to use Run Time Support services, the code which provides for compilation units processing, etc.). The i-nth optional subprogram includes the whole and only the

code that it has to execute on the i-nth processor.

In [APP B] section, MULTI_ADA286 program SCL text is reported. The rules described here have been applied to this text.

3.4 Linker use in multi generation

In Ada programs multi generation, the use of automatic mode is recommended as it makes generation easier.

As in the case mono, a default graph to which 'ada'_graph logic is associated, which exports a multi architecture [APP. B] is delivered.

If the user decides to adopt its own graph for generations, it must reassign 'ada'_graph logic to this graph.

The templates of 'ada'_graph that the user wants to use for multi generation are to be builded following these rules:

1. The name of the template must begin with the prefix MULTI_ because the linking process adds always MULTI_ to the template name specified in the invoking command.

For the use of /TEMPLATE qualifier in multi generations the same rules of case mono applies:

A) If /TEMPLATE is not specified in linker invocation command, the following rule is valid:

<template name> = MULTI_<graph name>

(as Ada linker, for multi generations, which can be recognized by means of the use of /CLUSTERIZATION and /PROCESSOR_ASSIGNMENT qualifiers, assigns as template name composed of the prefix MULTI_ followed by the name of the graph.
(see rule a) par. 1.1.2.1).

· Example

```
$ define ada286_graph MYGRA.GRA
$ Ada286/link/ofd=.../clu=.../proc=... MYPROC
```

means that the template which is to be used in MYGRA.GRA is:

<template name> = MULTI_MYGRA

B) If /TEMPLATE is partially specified, the following rule is valid:

<template name> = MULTI_<main unit>

Ada linker, for multi generations which can be recognized by means of the use of /CLUSTERIZATION and /PROCESSOR_ASSIGNMENT qualifiers,

assigns to the template a name composed of the prefix MULTI followed by the name of the main unit (see rule b) par. 1.1.2.1).

· Example:

```
$ define ada286_graph MYGRA.GRA
$ ada286/link/ofd=../lib=../clus=../proc=../template  MYPROC
```

means that the template which is to be used in MYGRA.GRA is

```
<template name> = MULTI_MYPROC
```

C) If /TEMPLATE is totally specified

```
/TEMPLATE = <template>
```

the following rule is valid:

```
<template name> = MULTI_<template>
```

Ada linker, for multi generations, which can be recognized by means of /CLUSTERIZATION and /PROCESSOR_ASSIGNMENT qualifiers, assigns to the template a name composed of the prefix MULTI followed by the name of the template (see rule c) par 1.1.2.1).

· Example:

```
$ define ada286_graph MYGRA.GRA
$ ada286/link/ofd=../lib=../clu=../proc=../temp=MYTEMP MYPROC
```

means that the template which is to be used, in MYGRA.GRA graph is:

```
<template name> = MULTI_MYTEMP
```

NOTE:
If linker invocation command is:

```
ada286/link/ofd=../lib=../clu=../proc=../temp=MULTI_MYTEMP MYPROC
```

then

```
<template name> = MULTI_MULTI_MYTEMP
```

MYGRA.GRA graph used in the examples above, is done as follows:

SCL text:

```
system MYGRA;
program template MULTI_MYGRA..
end program;

program template MULTI_MYPROC..
end program;
```

```
  program template MULTI_MYTEMP..
  end program;

  program template MULTI_MULTI_MYTEMP..
  end program;

      ...

end system;
```

- The use of CG_ADAMAINPROGRAM as "initial procedure" name to be given in SCL is recommended.

- The use of ELABORATION (exported by the anonymous task) as name of the assembler module to be included in GENERAL subprogram is recommended.

2. The following logics must be defined before of the graph compilation, otherwise SCL286 Compiler fails.

The logics to be defined are:

- REPEATED must be defined on a file REPEATED.INC initially empty.

- ZONEi (i = 0..15) must be defined on a file ZONEi.INC initially empty

- SUBPROGRAMASSIGN must be defined on a file SUBPROGRAMASSIGN.INC initially empty

The ada linker will associate the *.INC files to the opportunes .OBJ

3. The name of the "initial procedure" given in the example of [APP B] is CG_ADAMAINPROGRAM which is an equ defined on CG?ADAMAINPROGRAM. CG?ADAMAINPROGRAM is the name of the public procedure of <main>_ELAB.ASM which gives the elaboration order of an Ada program.

4. As name of the assembler module to be included in the GENERAL subprogram the user can use ELABORATION ([APP B]).
This is a logic that the linker will provide to assign to the last <main>_ELAB.ASM produced.

If there is the use of the qualifiers /SEARCHLIB and /INTERFACED in a multi generation there is the insertion of the specified interface modules (object files or libraries) only in the subprogram GENERAL of type repeatable.
It is impossible to insert interface units not ADA in types of subprogram not repeatable because the last cannot be inserted in the cluster specifications.
The names of the interface files specified with with the qualifiers above must follow SCL sintax, in fact they must be processed by SCL286 compiler.

3.4.1 Linker Use Example

Ada multiprocessor programs generation.

Given the following Ada text:

```
with Ada_RTS;use Ada_RTS;
package COMPUTER_0 is
  task PROCESSOR_0 is
      entry ARE_YOU_THERE(no : out computer_id);
  end PROCESSOR_0;
end;
package body COMPUTER_0 is
  task body PROCESSOR_0 is
      begin
          accept ARE_YOU_THERE(no : out computer_id) do
              no:= my_computer;
          end ARE_YOU_THERE;
      end PROCESSOR_0;
end COMPUTER_0;

with Ada_RTS;     use Ada_RTS;
package COMPUTER_1 is
  task    PROCESSOR_1 is
      entry ARE_YOU_THERE(no : out computer_id);
  end PROCESSOR_1;
end;
package body COMPUTER_1 is
  taskbody PROCESSOR_1 is
      begin
          accept ARE_YOU_THERE(no : out computer_id) do
              no:= my_computer;
          end ARE_YOU_THERE;
  end PROCESSOR_1;
end COMPUTER_1;

with Ada_RTS;     use Ada_RTS;
package COMPUTER_2 is
  task PROCESSOR_2 is
      entry ARE_YOU_THERE(no : out computer_id);
  end PROCESSOR_2;
end;
package body COMPUTER_2 is
  task body PROCESSOR_2 is
      begin
          accept ARE_YOU_THERE(no : out computer_id) do
              no:= my_computer;
          end ARE_YOU_THERE;
      end PROCESSOR_2;
end COMPUTER_2;
```

```
with REPORT;use REPORT;
with Ada_RTS; use Ada_RTS;
with COMPUTER_0; use COMPUTER_0;
with COMPUTER_1; use COMPUTER_1;
with COMPUTER_2; use COMPUTER_2;
procedure FIRST is
 which_computer : computer_id;
begin
  text( "FIRST","Processor migration occurs"&
       "during context processing");
      comment("PROCESSOR_0 is active");
      PROCESSOR_0.ARE_YOU_THERE(which_computer);
      if which_computer /= 0 then
          failed("PROCESSOR_0 is not on processor 0");
      end if;
      comment("PROCESSOR_1 is active");
      PROCESSOR_1.ARE_YOU_THERE(which_computer);
      if which_computer /= 1 then
          failed("PROCESSOR_1 is not on processor 1");
      end if;
      comment("PROCESSOR_2 is active");
      PROCESSOR_2.ARE_YOU_THERE(which_computer);
      if which_computer /= 2 then
          failed("PROCESSOR_2 is not on processor 2");
      end if;
  result;
end first;
```

Clusterization file:

```
FIRST
*
      FIRST

POLO_0
*
      COMPUTER_0

POLO_1
*
      COMPUTER_1

POLO_2

      COMPUTER_2
```

File of assignment to processors:

```
FIRST 0001
POLO_0 0001
POLO_1 0002
POLO_2 0004
```

4 Ada Run Time Supports

Ada Run Time Supports for Ada applications execution are mainly located in Kernel Program of the Initial Program of an Alenia target computer. This means that the application needs very few codes to gain access to such run time supports.

This code is defined by the following set of OMF modules which are part of the cross compiler installation kit.

```
module    :FMS:ADARTSA1/RTSDATA.OBJ       relocatable;
module    :FMS:ADABIOA1/BIODATA.OBJ       relocatable;
. . . .
module    :FMS:ADABIOA1/BINDER286.LIB     relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB     relocatable;
module   DACS86A0:RTHELP286.LIB           relocatable;
```

The first two modules define a data segment reserved to system data. It is accessed only by run time system during the program elaboration. The last three modules define all run time support services required by Ada program elaboration.

The user must assure that the two .OBJ modules and the three .LIB modules, respectively go first and follow all compiled Ada code (see [DPG]).

Accordance with the above requirements enforces first the correct relocation of run time system data in thereserved data segment. Secondly, it guarantees the visibility of the procedural supports of the run time system which is delivered in the .LIB modules.

5 TASK CONFIGURATION

Any task declaration is configurable with respect to the priority used by Run Time System to elaborate task and with respect to dynamic storage size and allocation required by task elaboration. We briefly recall the way to give default values for following configuration items which must be supplied in each Ada program generation.

1) task priority;
2) task segment size and allocation;
3) task stack size;

Few examples guide the user in introducing this information into the program.

5.1 Task Priority

For the current version of ADARTS and for the old ones the following rules applied.

1. Default priority of the anonymous task id fixed at SCL time with the priority directive.

```
initial process on 0 priority 2;
```

It can be modified using the pragma priority with values from 0 to 7. Note that priority'FIRST is equal to 1 (for the current version).

2. All other tasks start with a priority equal to the SCL value spacified for the main program, this priority can be changed by the use of pragma PRIORITY. Inner task ineredits the priority of parent task.

5.2 Task Segment Size

A stack segment is reserved for each library task and for each main program.

For each task is reserved a portion of stack (Stack Branch) in the stack segment; the branch stack for an inner task (that is a task whose implicit or esplicit type is contained in an Ada frame - Ada Reference Manual par 11.2) is allocated in the same stack segment of the task which has activated it.

The size of the stack segment of the main can be specified in the following ways:

- STACKSEGMENT SIZE = N

(SCL statement; N hex value): it is the size in bytes of the stack segment created for the Main Task.
Its value is specified in the Program Template of the Ada program.
The linker qualifier /MP_SEGMENT_SIZE = N has no effect.

scl text:

```
/* scl declarative part.
*/

initial procedure CG_AdaMAinProgram
stacksegment nodal size = OFFOOH;
```

The size of the stack segment for a library task is specified by:

- /LT_SEGMENT_SIZE = N

(linker qualifier): specifies default segment size for all library tasks to be N words (decimal value).
If this value is not specified the default is the size expressed in SCL for the main.

- pragma LT_SEGMENT_SIZE(T, N)

(part of Ada source text): specifies segment size for library task T to be N words (decimal value) if it is a Library Task.

- Function SET_CHILD_SEGMENT_SIZE exported from the package ADA_RTS ([APX A]);
the size is expressed in word.

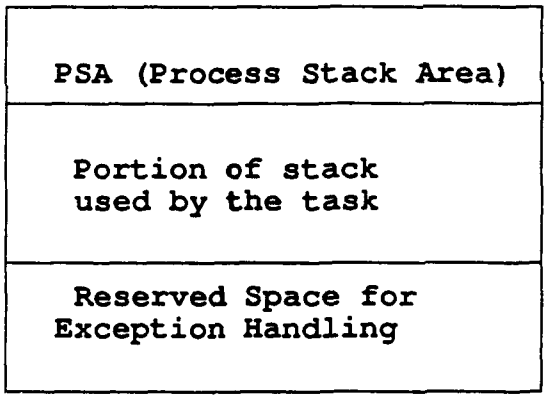
The size of the stack segment includes always the Page Map that is the two pages reserved on the stack for the Run Time Support of Ada.

Furthermore, the stack segment size specified and the stack segment size actually used aren't the same, because the ADARTS provides to add some words for page alignment.

5.3 Task Stack Size

For each task is reserved a portion (Task Branch) in the stack segment allocated for it.

A branch has the following structure:



The Process Stack Area is an area where are stored some task informations; the size of this area is 12H storage units for a library task, while is 10H storage units for an inner task.
Under the PSA there is the part of the stack used by the task to allocate the various blocks during its execution.
There is also a zone reserved for the exception handling and its size is 50 storage units.
If the Main Task or a Library Task have no inner tasks (i.e. tasks that are not library tasks), then the Branch Size (page_aligned) can be up to the Stack Segment size minus 512; otherwise the sum of the Branch Size (page_aligned) of all the inner tasks depending from the main or a Library Task plus 512 must be less than the Segment Size.

The Stack Branch Size of a task can be specified in the following way:

- /MP_STACK_SIZE = N

(linker qualifier): specifies stack size for the main program to be N words; it is the default value for /LT_STACK_SIZE.

- /LT_STACK_SIZE = N

(linker qualifier): specifies default stack size for library tasks to be N words.

- /TASK_STORAGE_SIZE = N

(linker qualifier): specifies default stack size for all non-library tasks stacks to be N words.

- for T'STORAGE_SIZE use N

(part of Ada source text): specifies that the size of the stack for task type T should be N words.

The stack size specified and the stack size actually used aren't the same, because the ADARTS provides to add some words for page alignment

5.4 Example

The following example illustrates how to use the previous parameters in order to set segment size and stack size.

```
package library_tasks is
    task type t1;
    pragma lt_segment_size(t1,1000);
    for t1'storage_size use 550;
    tt1:t1;
    task t2;
    -- segment size = value of /LT_SEGMENT_SIZE
    -- stack size   = value of /LT_STACK_SIZE
end library_tasks;
package body library_tasks is
    task body t1 is
    ...
    end t1;
    task body t2 is
    task t21;
    -- stack size = value of /TASK_STORAGE_SIZE
        task t21 is
        ...
        end t21;
end t2;
end library_tasks;

with library_tasks;
proceiure main is
    task tm1;
```

```
      -- stack size = value of /TASK_STORAGE_SIZE
      task body tm1 is
      begin
          null;
      end tm1;
      -- stack size of main = value of /MP_STACK_SIZE
  begin
      null;
  end main;
```

SCL text:

```
      program template main
          .
          .
      initial procedure main
          stacksegment nodal size = 0FF00H;
      end program;
```

Suppose that the linker command has the following qualifiers:

```
/MP_STACK_SIZE        = 7000
/LT_SEGMENT_SIZE  = 8000
/LT_STACK_SIZE        = 600
/TASK_STORAGE_SIZE    = 900
```

The program given in the example contains a main task, two library task (TT1, T2) and two inner task (T21, TM1). Here there is the allocation of three stack segments:

- one stack segment with size = 0FF00H bytes for the main task (by STACKSEGMENT SIZE = 0FF00H)
- one stack segment with size = 1000 word for the library task TT1 (by PRAGMA LT_SEGMENT_SIZE)
- one stack segment with size = 8000 word for the library task T2 (by /LT_SEGMENT_SIZE)

Moreover there will be the allocation of the following branches inside the stack segment above mentioned:

- one branch stack for the main task with size = 7000 word (by /MP_STACK_SIZE)
- one branch stack for the library task TT1 with size = 550 word (by length clause)
- one branch stack for the library task T2 with size = 600 word (by /LT_STACK_SIZE)
- one branch stack for the inner task T21 with size = 900 word (by

/TASK_STORAGE_SIZE) in the stack segment of T2

- one branch stack for the inner task TM1 with size = 900 word (by /TASK_STORAGE_SIZE) in the stack segment of the main

6 Objects Dynamic Allocation

6.1 System Heap

System Heap is a segment in which collections without associated length clauses are allocated.

- Example:

```
type ARR1 is array (1..10) of integer;
type ARR2 is array (1..15) of integer;
type PUNT1 is access ARR1;
type PUNT2 is access ARR2;
.
var1 : punt1;
var2 : punt2;
```

Objects of ARR1, ARR2 type, created with NEW allocator, form a collection in which no length clause has been fixed, consequently they are allocated in System Heap.

System Heap segments are created as nodal or local according to indications in SCL concerning data segments allocation.

If data segments allocation has been fixed in nodal memory, System Heap segments will be nodal, too.
Similarly, if data segments allocation is in local memory, System Heap segments will be local.

6.2 Heap Segment

Collections with applied length clause are allocated in Heap Segments.

- Example:

```
type ARR1 is array (1..10) of integer;
type ACC1 is access ARR1;
for ACC1SIZE use 80;
VAR1 : ACC1;
```

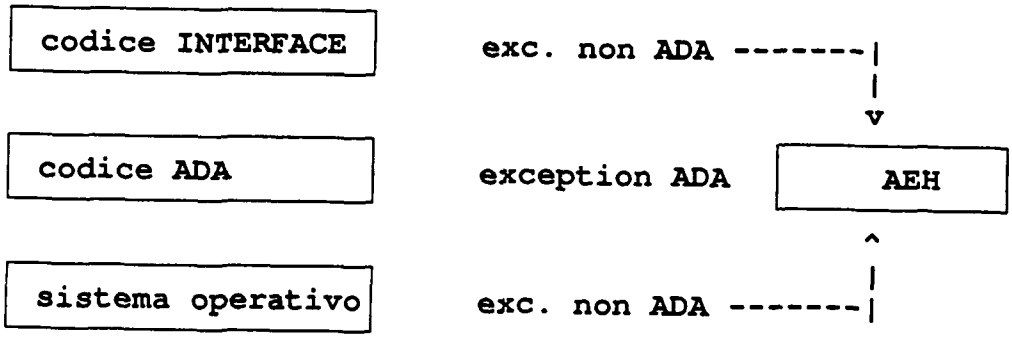
The same rules valid for System Heap apply to Heap Segments allocations in nodal or local memory.

7 Exceptions handling

This subsection describes process Exception Handling (AEH) and function Exception Handling supplied by Run Time Support for the execution of ADA programs.

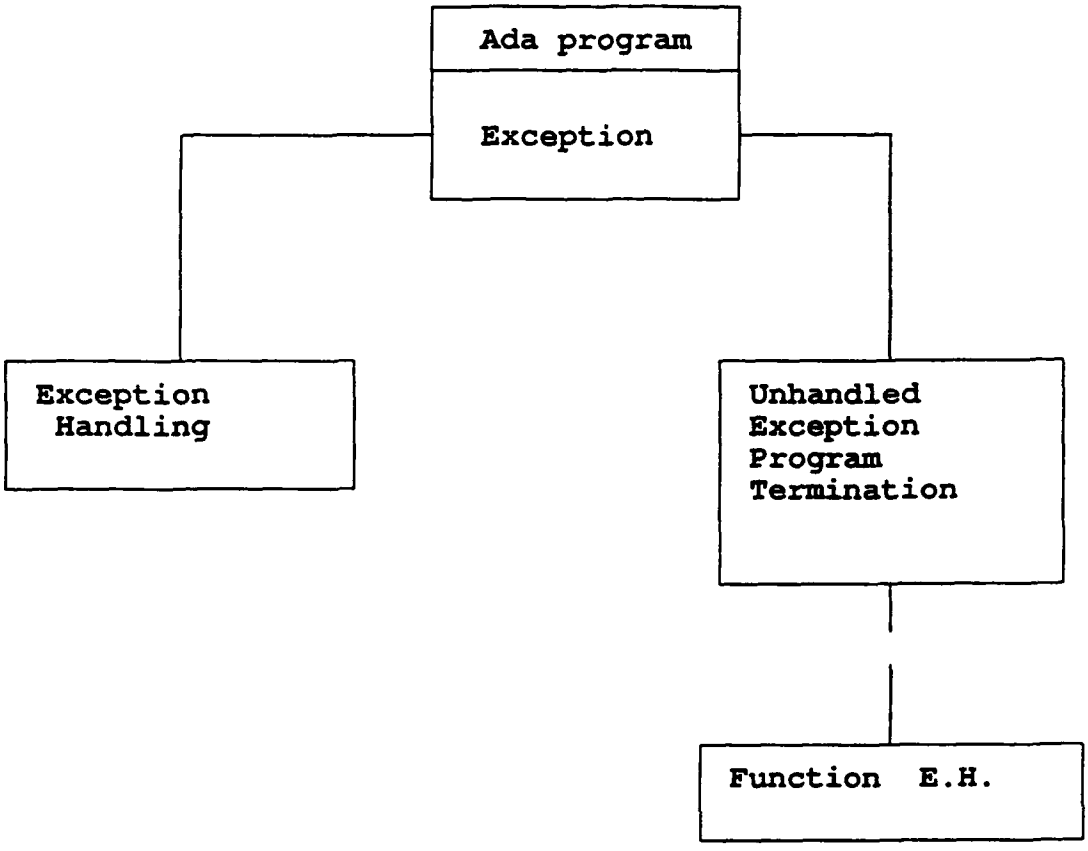
AEH is the process Exception handling associated to any process which implements an ADA task.

It is activated whenever there is an exception, whether it is Ada or is not Ada.



- fig. 1 -

Function Exception Handling is activated by RTS when main program processing concludes because of unhandled exceptions



- fig 2 -

7.1 Process Exception Handling

Ada Exception Handling (AEH) is part of Run Time Support (RTS), whose ask is to perform exceptions handling policies according to description in [LRM] chapter 11.

AEH handling policies vary according to the following factors:

- frame typology (see 11.2 - [LRM])
  - block statement
  - body of subprogram, package, task, generic unit

- statement typology

  · declarative
  · executive

- presence or absence of 'exception handler'

AEH must search a handler for the raised exception and consequently perform the following actions:

- if there is a handler in the damaged frame:

  · transmit control to it

- if there is no handler in the damaged frame, look after:

  · propagating exception until handler is detected, without overcoming task or main program level
  · terminating the program in execution, when propagation is arrived at main level

7.2 Function Exception Handling

Function Exception Handling is activated when a specific exception, being not handled, propagates until the most external program level causing, as a consequence, the termination of the program itself.

Each function possesses a default function exception handling.

Anyway, implementation makes a function and non-default Exception Handling available, which executes main history layout starting from the damaged block.

It is actually an RTS optional component which the user can profit by only if it has been explicitly activated.

Activation specification and function EH layout structure supplied by the implementation are described in section 6.6 .

7.3 Interaction specification with process EH

This chapter describes AEH different behaviour depending on execution code, that is Ada code or non Ada code performed by Ada task through subroutine calls to which Pragma INTERFACE has been applied

Exceptions can be raised during Ada task execution:

· caused by Ada code execution

· caused by non Ada code execution

The former case includes all those anomalous circumstances described in terms of the 5 predefined exceptions as well as those anomalous

circumstances expressed through non-predefined exceptions declaration.

All the exceptions of this group are handled by process AEH according to language rules (see 11 - [LRM]).

The latter case includes all those exceptions causes due to the operating system and to subroutines execution
through pragma INTERFACE.

Typically, anomalous circumstances in this latter case are detected either by interrupt mechanisms or by calls to RaiseException.

AEH is informed of such events through appopriate error codes listed in [KERNEL] Appendix 15.

The example shows exceptions raised in Ada code and non Ada code:

Case 1 - exceptions in Ada code

```
procedure PROVA1 is

  A:array(1..10) of INTEGER;

begin

  for I in 1..20 loop

      A(I):=0;                    - CONSTRAINT_ERROR is raised here

  end loop;

exception

  when CONSTRAINT_ERROR    =>...; - CONSTRAINT_ERROR is handled h re

  when others              =>...;

 nd PROVA1;
```

```
with TEXT_IO;use TEXT_IO;
procedure RAISING is
  MY_EXCEPTION :exception;
begin
  raise MY_EXCEPTION;
exception
  when MY_EXCEPTION   =>  PUT_LINE( my exception );
                          NEW_LINE;
  when others         =>  PUT_LINE( predefined exception );
                          NEW_LINE;
end RAISING;
```

- fig.3 -

Case 2 - exceptions in non Ada code

```
MAIN:do;
RAISEEXCEPTION : procedure (p1,p2,p3,p4) external
  declare (p1,p2,p3,p4) word;
end RAISEEXCEPTION;
FOREIGN : procedure public;
  ...
  CALL raiseexception(0E081H,0,0,0);
  /* 0E081H is raised here */
end FOREIGN;
end MAIN;
```

```
procedure PROVA2 is
  procedure FOREIGN;
  pragma interface(PLM_ACF,FOREIGN);
begin
  FOREIGN;                    - 0E081H is raised here
exception
  when STORAGE_ERROR          => ... ;
  when others                 => ... ;
end PROVA2;
```

- fig.4 -

The handling of exceptions raised during non Ada code execution is performed by AEH through exception propagation into Ada code and through a default mechanism which translates each non Ada exception into one of the 5 predefined Ada exceptions.

In addition, the programmer may also define his own transposition mechanism to translate non Ada exceptions into predefined and not Ada exceptions.

In this case, the programmer himself must lead AEH to use such non-default associations. The way to implement this will be shown later on in this paragraph.

Transposition mechanism supplied by AEH, what will be later called default, performs the following associations:

A030H	storage_error
C031H	program_error
C032H	program_error
C034H	program_error
C035H	program_error
C03BH	program_error
A03CH	storage_error
A03DH	storage_error
A03EH	program_error
A042H	program_error
C052H	program_error
C06EH	constraint_error
E06FH	program_error
E073H	program_error
C075H	numeric_error
C076H	numeric_error
E079H	program_error
C080H	program_error
E081H	storage_error
C0F0H	numeric_error
E0F1H	program_error
A410H	storage_error
A411H	storage_error
A412H	storage_error
A414H	storage_error
C421H	program_error
C422H	program_error
C423H	program_error
C427H	program_error
C429H	program_error
C42EH	program_error

- fig. 5 - Default association table

Note that all non Ada exceptions codes present in default table are translated by AEH into FOREIGN_EXCEPTION Ada exception defined in package SYSTEM.

Therefore, the previous example in fig. 4 can be updated folowing use in the given table, as shown :

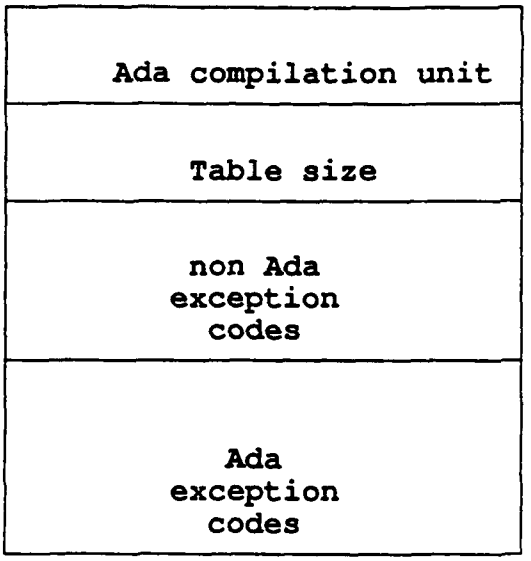
Case 2:

```
MAIN:do;
RAISEEXCEPTION : procedure (p1,p2,p3,p4) external;
declare (p1,p2,p3,p4) word;
end RAISEEXCEPTION;
FOREIGN:procedure public;
...
CALL raiseexception(0E081H,0,0,0);
/* 0E081H is raised here */
end FOREIGN;
end MAIN;


procedure PROVA2 is
procedure FOREIGN;
pragma interface(PLM_NOACF,FOREIGN);
begin
FOREIGN;                                  - STORAGE_ERROR is reraised here
exception
when STORAGE_ERROR          =>...;    - STORAGE_ERROR is handled here
when others                 =>...;
end PROVA2;
```

- fig . 6 -

Whenever the user need to define different associations from default ones, than he must write a table the way is shown in figure 7 :



- fig.7 - Association table

'Ada compilation unit' field must contain the number (taken in ADA sublibrary) of compilation unit in which has been declared.

The number of compilation unit can be found through 'Program Library Utilities'(see chap. 4 [User's Guide]).

'Table Size' is the number of exceptions codes listed in one of the following subtables.

In 'Non Ada exception codes' field non Ada exception codes must be listed , that the user wants to translate based on his associations.

In 'Ada exception codes' field Ada exceptions codes are listed (predefined and not), chosen by the user to translate the errors list given in the previous field.

Each element in the assosciation table must occupy a 16 bits space.

'Non Ada exception code' and 'Ada exception codes' must clearly contain the same codes number (one to one association between the two subtables entries).

Figure 8 reports the example of association table supplied by the user:

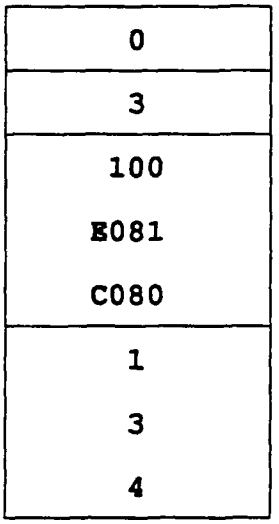


fig 8

Note:

Each exception is defined through a double word (definition is given in package STANDARD)

one word containing the compilation unit defining it

one word containing progressive declaration order

From table in figure 8 we desumw that:

1) The compilation unit is that of package STANDARD (0 is it number in root sublibrary) which contains the definition of the 5 predefined Ada exceptions

2) Entry number of each subtable is 3

3) Implemented associations are:

```
0100H  -->  0:1     or CONSTRAINT_ERROR
0E081H -->  0:3     or PROGRAM_ERROR
0C080H -->  0:4     or STORAGE_ERROR
```

The user must lead AEH to use its own non_default association table (not default one) and this occurs when you give significant values to RaiseException procedures parameters and precisely the following:

- The value of P1 parameter must be such that, after performing a logic AND with a "1700" value it preovides still "1700" result (P1 and 1700 = 1700).

- "P2" and "P3" parameters must contain the pointer to association table (P2 = selector and P3 = offset).

- "P4" parameter must be exception code as is listed in "Non Ada exception codes" subtable.

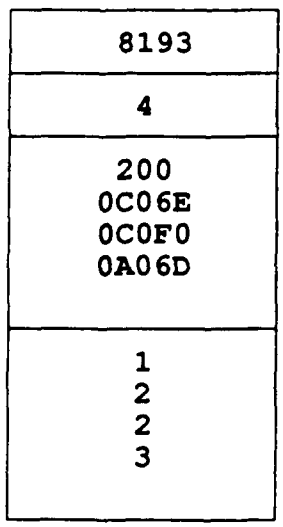
Let's analyze now the following example:

```
package PACK is
  procedure FOREIGN;
  CONTRAINT_ERROR   :exception;
  OLD_EXCEPTION     :exception;
  MEW_EXCEPTION     :exception;
private
  pragma INTERFACE (PLM_ACF, FOREIGN);
end PACK;
```

```
WITH pack;
  procedure PROVA is
  begin
   PACK.FOREIGN;
  exception
    when PACK.CONSTRAINT_ERROR  => null;
    when OLD_EXCEPTION          => null;
    when others
 end PROVA;
```

Suppose that:

- 8193 is PACK compilation unit number
- association table supplied by the user is structured as follows:



- fig.10 -

The user chooses the following associations:

```
0200H     -->   8193:1        or      CONSTRAINT_ERROR
0C06EH    -->   8193:2        or      OLD_EXCEPTION
0C0F0H    -->   8193:2        or      OLD_EXCEPTION
0A06DH    -->   8193:3        or      NEW_EXCEPTION
```

In order to use his own association table, the user must:

- declare the table

- perform calls to RaiseException according to the rules given before

Here is an example of use:

```
MAIN:do;
RAISEEXCEPTION:procedure (P1,P2,P3,P4) external;
declare (P1,P2,P3,P4) word;
end RAISEEXCEPTION;
FOREIGN: procedure public;
declare TABLE (*) word data   (        8193H,
                                          4,
                                        200H,
                                      0C06EH,
                                      0C0F0H,
                                      0A06DH,
                                          1,
                                          2,
                                          2,
                                          3 );
declare PTR pointer;
declare (MYOFF,MYSEL) word at (@PTR);
declare RESULT word;

PTR = @TABLE;
/* <call to Kernel procedures> */
if RESULT <> 0 then
call RAISEEXCEPTION(1701H,MYSEL,MYOFF,200H);
/* <call to Kernel procedures> */
if RESULT <> 0 then
call RAISEEXCEPTION(1701H,MYSEL,MYOFF,0C06EH);
end FOREIGN;
end MAIN;
```

- fig.11 -

- NOTE: CONSTRAINT_ERROR exception declared in PACK package is different from CONSTRAINT_ERROR declared in STANDARD package.
  While the former is identified by (8193:1), the latter is identified by (0:1).

In some cases process AEH behaviour is not dictated by language rules, but depends on implementation.
Particular cases are analysed below:

- overflow situations in real or fixed type operations are not declared by NUMERIC_ERROR, but the user can detect them using MACHINE_OVERFLOWS attribute (see C.1.3 Users Guide, see. 4.5.7 - Reference Manual).

- memory violation is declared as PROGRAM_ERROR. stack

- overflow and underflow cases are declared as STORAGE_ERROR.

7.4 Use of Exception_Code

ADA_RTS package, present in Ada Program Library, exports a function called Exception_Code, which returns in an UNSIGNEDWORD type variable (defined in package SYSTEM) the code of the last non Ada exception raised during a program.

If no non Ada exception has been raised, it returns value 1700H.

This function is particularly useful in case the association performed by AEH or chosen by the programmer is such that FOREIGN_EXCEPTION is notified as non Ada exception raised during the execution of a program.

An example of use is given below:

```
with SYSTEM;use SYSTEM;
with ADA_RTS;use ADA_RTS;
with TEXT_IO;use TEXT_IO;
procedure P_PROC is
procedure FOREIGN;
pragma interface (PLM86,FOREIGN);
package PUT_UNS_W is new INTEGER_IO(UNSIGNEDWORD);
use PUT_UNS_W;
MARA_EXC : UNSIGNEDWORD := 0;
begin
  FOREIGN;   - raises STORAGE_ERROR;
exception
  when STORAGE_ERROR => MARA_EXC := EXCEPTION_CODE;
                  PUT_LINE (   The original code  &
                                of non Ada exception is: );
                  PUT(MARA_EXC,BASE=>16);
                  NEW_LINE;
 when others        => PUT_LINE( other exception );
                  NEW_LINE;
end P_PROC;
```

- fig.12 -

7.5 Printout Of Exception Spelling

The package ADA_RTS contains two function:

- RTS_GetExceptionId
- RTS_GetExceptionSpelling

which are necessary to obtain the complete name of the last exception occurred.
In fact from the release 4.6, ADA compiler allows the retrieval of full spelling for raised exceptions.
The linker extracts all exception spellings from all ingoing units and places them in the elaboration code module from which they may be identified. So there is the use of two routines: one to retrieve the last raised exception (RTS_GetExceptionId) and one to translate an exception identifier into a string (RTS_GetexceptionSpelling).
Here is an example of the use of these procedures in a program where there is the declaration of some exceptions:

Example:

```
with Text_IO; use Text_IO;
with System; use System;
with Ada_rts; use Ada_rts;
 procedure excspell is

  temp_outside_limit:exception;
  fire, break_in:exception;
  stack_overflow, stack_underflow:exception;

  begin

   raise fire;

   exception

   when fire =>
             put(RTS_GetExceptionSpelling(RTS_GetExceptionId));

 end excspell;
```

7.6 Use of pragma INTERFACE

Pragma INTERFACE form is the following (see C.2.4 - [User Guide]):

pragma INTERFACE (language_name, subprogram_name).

<language_name> types allowed by the implementation are defined in package SYSTEM (see. F.3 - Users Guide).

<Language_name> can be followed by the following annotation:

_ACF or _NOACF.

_ACF annotation notify to AEH that you have passed from Ada code to non Ada code, therefore exceptions handling policy must follow the rules valid for this case and expressed previously in this section.

If <language_name> is of _NOACFS type, AEH cannot individuate Ada code from non Ada code and its exceptions handling politic follows given rules for handling of exceptions from Ada code, ignoring completly the fact that it works in non Ada context.

This situation does not preserve the user from incorrect exceptions handling.

PLM86 and PLM_ACF annotations are equivalent, in fact both ensure exceptions handling.

Similarly for C86 and C_ACF.

On the contrary, for ASM86<language_name> the rule is the following:

ASM86 is equivalent to ASM_NOACF, while ASM_ACF use ensures the handling of exceptions raised in non Ada code.

7.7 Use of Trace_info Procedure

From the version 1.5 of ADARTS and from the version 4.5.4.1 of ADA compiler it'is possible to use a procedure which gives some informations related to the address and the identifier of an exception raised in an ADA program.

The name of this procedure is : Trace_Info .

The specification of this procedure is contained inside the package ADA_RTS, the body is written in ASM286.
The procedure Trace_Info has a parameter (in out) of a type record declared
in the package ADA_RTS too.

The spacification of the procedure is :

```
procedure TRACE_INFO(PSA : in out PSA_REC);
pragma interface (ASM286, TRACE_INFO);
```

The declaration of the record type is:

```
type PSA_REC is
    record
        Unit_no             : system.unsignedword;
        Exception_id        : system.unsignedword;
        Mara_code           : system.unsignedword;
        Exception_offset    : system.unsignedword;
        Exception_selector  : system.segmentid;
    end record;
```

[NOTE - the type UnsignedWord is defined in the package SYSTEM.]

The fields UNIT_NO and EXCEPTION_ID of PSA_REC give some informations about the exception identifier.

The field MARA_CODE give the original code of the exception.

The fields EXCEPTION_SELECTOR and EXCEPTION_OFFSET give the address of the exception.

The TRACE_INFO procedure must be called inside an Ada Exception Handler defined in the same level or in a more external level respect to the block which has raised the exception.

The following procedure give an example about the use of the Trace_Info.

```
with TEXT_IO; use TEXT_IO;
with SYSTEM; use SYSTEM;
with ADA_RTS; use ADA_RTS;

procedure main is
  psa: psa_rec;
  package my_uns is new integer_io(unsignedword);
  use my_uns;
begin
  raise storage_error;
exception
  when storage_error => ada_rts.trace_info(psa);
                        put_line("the exception address is:");
                        my_uns.put(psa.exception_selector,base =>16);
                        my_uns.put(psa.exception_offset,base =>16);
                        new_line;
                        put_line("the original exception is:");
                        my_uns.put(psa.mara_code,base =>16);
                        new_line;
                        put_line("the exception identifier is:");
                        my_uns.put(psa.unit_no,base =>16);
                        my_uns.put(psa.exception_id,base =>16);
end main;
```

7.8 Interaction specification with function EH

This paragraph shows behaviuor of optional function EH supplied by the implementation and the ways to set it.

It is called optional because it works only after it has been explicitly set, otherwise default
or previuosly set one is inherited (if setting has occurred).

Function EH provided by RTS executes a main program evolution tracing, terminated because of

unhandled exception, from the exception point up to its deactivation.

Tracing shows the following information:

- identifier of the raised exception
- identifier of the damaged block which can be a block statement or a subprogram.
  As regards the subprogram, the subprogram starting address is supplied, too.

The last information is repeated for all activated blocks until main program is attained.

The following example reports an Ada program tracing which does not include the handling of possibly raised exceptions:

```
procedure APPLICATION is
procedure INTERNAL is
begin
raise PROGRAM_ERROR;  - not handled
end INTERNAL;
begin
begin                    - inner block
INTERNAL;               - subprogram call
end;
end APPLICATION;
```

- fig. 13 -

Tracing is:

```
START OF TRACING

Unit number and exception identifier: 0000:0003
Unhandled exception raised at: 0067:0039

Trace back follows:
BP value is: FDB6
Subprogram entry point is: 0067:0028

BP value is: FDC8
Inner block

BP value is: FDD8
Subprogram entry point is: 0064:0010

BP value is: FDDE
Subprogram entry point is: 007C:0008
```

```
BP value is: FFFF

END OF TRACING
```

- fig. 14 -

Unit number and exception identifier is the exception identifier.

Unhandled exception raised at provides the exception original address.

BP value is is BP register value (BP detects frame univocally). Subprogram entry point is is the subprogram starting address (if the frame is a block statement, inner block nformation will be visualized).

Optional function EH is visible to the user as an Ada procedure called Unhandled_Exception_Tracer and is exported from ADA_RTS package present in Program Library.

Therefore, setting function EH means simply to perform a call to Unhanded_Exception_Tracer procedure.

It is important to consider that such function EH works from call point to Unhanded_Exception_Tracer procedure and that therefore, only from that moment onwards is it possible to get the tracing of applications which are performed later on.

There are various ways to set such function EH.

You can either generate a program in LTL format to be performed before any other application program, or generate an IPL program having as Initial Program the procedure which performs call to Unhanded_Exception_Tracer.

We report the simpler example, the generation of a unique LTL for the following program:

```
with ADA_RTS;use ADA_RTS;
procedure TRACE is
begin
UNHANDLED_EXCEPTION_TRACER;
end TRACE;
```

- fig.15 -

The execution of TRACE program LTL provides to set function EH supplied by the implementation.

From now on all performed Ada application programs will be traced as shown in figure 14.

It is possible to imagine more complex situations than the above one in which call to Unhanded_Exception_Tracer procedure can be inserted, but the programmers greater effort consists
in detecting its application point in which tracing can be activated, because it is only from that moment onwards that it can be implemented.

8 Concurrency tracing

Support to the execution of Ada codified programs -ADA_RTS- provides a tracing performance of points relevant to program tasking activity.

From now on, we will refer generically to these points calling them synchronization points of global tasking programmed in the application.

This service is performed with the output - on TRACER_DEVICE path - of text lines whose meaning and format is described in trace meaning and trace structure sections.

TRACER_DEVICE is defined in (SCL) product static configuration phase.

The availability of this path is necessary for this service to be executed.

This is an optional service. Whether it is included or not in the Initial Program of a MARA node, this service is ruled by means of ADARTS_TRACING further parameter of the above configuration.

8.1 Trace lines structure

A trace line is structured as follows:

```
<line>    ::= <action> <task> in <entry> at <time> [ for <delay> ]

<action>  ::=       Initialized program :
| Identified
|   Awaked
|   Slept
|   Timed slept
|   Deleting
|   Creating
| Terminated program  :

<task>        ::=     <word>

<word>        ::=     <hex><hex><hex><hex>

<hex>         ::=     0 | 1 | ... | E | F

<entry>   ::=     <identifier>:<address>
```

```
<identifier>   ::=     E_INIT | E_TERM | E_CRET | E_ACTT | E_ACTD
| E_LVBL | E_LBKT | E_LVMB | E_COMP | E_DELY
| E_CEUN | E_CETI | E_SLCT | E_ACPT | E_SYNC
| E_RVCO | E_RVFA | E_ABRT | E_STSZ | E_TRMD
| E_CABL | E_ECNT | E_TIDN | E_COMP | E_CHLC
| E_SGSZ | E_CHSS | E_ECOD

<address>     ::=     <word>

<time>            ::=     <word><word>

<delay>   ::=     <word><word>
```

Example A:

```
Initialized program  : 000C

Identified   000C in E_COMP:072E at 005B11DE
Identified   000C in E_TERM:1886 at 005B1242

Terminated program  : 000C
```

8.2 Trace lines meaning

The elaboration of an Ada text programming one or more of the definitions described in chapter 9 of language manual, determines the univocal identification of points in the text in which actions described in that chapter must occur.

These actions are performed by Run Time System (RTS) from appropriate procedures directly called by the compiled code, i.e. produced by Ada compiler.

These procedures are dirctly performed by the task processing Ada text at issue, and trace lines provide
<action><word> identification of that task.

When the tracing mechanism is present, these procedures trace the run of the task in process outputting the above lines in orderto indicate that the correspondig action is occurring.

Relevant events which are traced can be roughly classified in the following groups:

- Task creation and activation
- Communication between tasks
- Task dependences and termination
- Time management
- Task abnormal termination
- Tasks attributes

Some examples, pointing out the correspondence between a given Ada text and a possible tracing which can be obtained through its elaboration, are reported below.

The reader should carefully think about the term possible of the previous statement, taking into account that tasking means parallel executions .

For compactness reasons, Ada text can be replaced with the corresponding syntactic non_terminator , as shown in language manual.

The Ada text examples are from the language manual.

The mark => indicates the beginning of the expected layout after the elaboration of the previous text.

8.3 Example of Task declaration

```
task type keybord_driver is
  entry read(c : out character);
  entry write(c : in character);
end;
teletype : keybord_driver;
=>
Identified   <task> in E_CRET:<word> at <time>
```

8.4 Example of Task activation

```
A)
task resource is
  entry seize;
  entry release;
end;

procedure p is
  a,b : resource;
  c : resource;
begin
  - A, b, c tasks are concurrently activated before the
  - first instruction
=>
Identified   <task> in E_ACTT: <word> at <time>


B)

type keyboard is access keyboard_driver;
terminal : keyboard := new keyboard_driver;

=>
Identified  <task> in E_CRET:<word> at <time>
Identified  <task> in E_ACTT:<word> at <time>
```

C)

```
  task body protected_array is
      table : array(index) of item := (index => null_item);
  begin
=>
Identified  <task> in E_ACTD:<word> at <time>
```

9 TASKING AND TIME HANDLING

9.1 REAL_TIME_CLOCK Package

Provide for direct access to kernel Real Time Clock GetTime and SetTime procedural services.

The Type TIME counts the milliseconds in a day.

TIME_IO package can be used to exchange the values of type TIME objects with STANDARD_INPUT and STANDARD_OUTPUT. In case several tasks need to perform concurrent GET or PUT requests, the provision of a monitor task for TIME_IO package is recommended.

Example - REAL_TIME_CLOCK

```
With REAL_TIME_CLOCK; use REAL_TIME_CLOCK;
with TEXT_IO; use TEXT_IO;
procedure CLOCK is
  I : INTEGER;
  use TIME_IO;
begin
  for I in 1..10 loop
      PUT (PUTTIME);
      NEW_LINE;
  end loop;
end;
```

10 ADABIO PRODUCT

It is the IO support for the execution of Ada programs generated by Ada-DDC compiler 4.3 and following versions.

This version is compatible with:

firmware	v.4.0
genentry	v.4.0
scl26	v.4.0
genrp	v.4.0
genip	v.4.0

abs286	v.3.0
ker286	v.4.0
io286	v.4.0
adarts	v.1.0

and following versions.

In order to generate correctly this product, the following logic names must be given to the directories described below:

ADABIOA0 containing ADABIO sources
ADABIOA1 containing ADABIO object modules

INTELA0 containing INTEL factory modules

ADARTSA0 containing Ada Run Time Support modules
(ADARTS)

KER286A0 containing Kernel modules

For additional information, refer to ADARTS PRODUCT.

11 Input Output Packages

11.1 Ada File Objects and Mara External Files

Note the difference between:

- Object file: entity create by ADA program for I/O operation that last until the program termination

- External file: ADA environment external entity that last independently of the program and manage data to exchange

An Ada task can input or output Ada objects values from or towards Mara external files only after that these are connected to adequate Ada file objects declared in the program.

This connection can be operated with one of CREATE and OPEN primitives defind by i/o packages provided by the implementation. Each CREATE creates a new Mara file, and each OPEN opens a pre-existing file.

Given Mara external file bytes arrangement, the binary notation of values output towards a Mara file is operated in terms of bytes.

At present, no other Mara external file organization is used by the implementation for Ada objects values representation output towards a Mara file.

In the three following sections, implementation choices, concerning the representation of Ada objects values stored in Mara files with the three Ada input output standard models, are detailed.

These models are specified in SEQUENTIALIO, DIRECTIO, and TEXTIO

packages (see [LRM 83] chapter 14).

11.1.1 Ada Sequential Files

An Ada sequential file is a set of single type objects values which are accessible only by read operations according to a strict sequence in consecutive file positions. A previous write operation allows the creation of sequential files. These two modes are exclusive and cannot co-exist at the same time. RESET operation permits to modify file access by activating the transfers from the beginning of the file in the new mode. Sequential files OPEN activates the transfers from the beginning of the file.

This means that if it is a write open, the file previous contents are lost. RESET operation in OUTFILE mode acts as a new output open from the beginning of the file.

Therefore, file previous contents are lost. Reading sequential files accessed through a CREATE
request is considered as wrong, and causes USE_ERROR exception raising.

The number of Mara file bytes involved in a value recording is determined by associed types binary notation length.

Given the existence of composite types - whose binary notation has a width which is not statically known -, these types sequential files record these values on a number of bytes dimensioned on the maximum occupancy.

- Example:

```
type index is range 1..10;
type an_array is integer array(index range <>);
package array_io is new sequential_io(an_array);
```

Maximum width value for an AN_ARRAY object corresponds to 10 integers. An integer is represented by 16 bits. Thus, 160 bits are the width used to represent this value. Therefore, Mara files created through ARRAYIO package will record AN_ARRAY types objects values on 20 bytes.

```
a,b   :   an_array        :=          (1,2,3);
c,d     :   an_array          :=          (1,2,3,4,5,6,7,8,9,0);
array_io.write(array_io.some_file,a);
array_io.write(array_io.some_file,c);
array_io.write(array_io.some_file,b);
array_io.write(array_io.some_file,d);
```

At the end of this sequence, 80 bytes of Mara file associated to ARRAY_IO.SOME_FILE will be occupied: the first 6 are significant, 14 are not significant, then 20 plus 6 are significant, 14 non significant, and finally 20 are significant.

11.1.2 Ada Direct Files

An Ada direct file is a set of values of single type objects which are accessible in reading or in writing in a file position selected by an index in the interval 1 ..DIRECT_IO.POSITIVE_COUNT'LAST.

This index control is explicitly operable through appropriate subprograms.

The index of the first element is 1, the last element one is file length. Conventionally, 0 length files are empty.

When opened, a direct file places the current index at 1.

Direct files can be extended by placing the index beyond file current size.

Unlike sequential files, direct files can be opened in INOUT mode, and this allows to update the file without the need to close or activate RESET operations.

11.1.3 Ada Text Files

An Ada text file is a set of pages which are a set of lines that, in turn, are a set of characters. A text file characters, lines, and pages can be selected by indexes ranging in the interval which goes from 1 to an integer value which can be defined by means of SET_LINE_LENGTH and SET_PAGE_LENGTH
subprograms.

The lines in a page, and the pages in a text file cannot exceed the value TEXT_IO.POSITIVE_COUNT'LAST.

Ada TEXTIO includes the UNBOUNDED constant in order to handle text file lines and pages with an unbounded number of characters per line, and of lines per page.

Lines and pages are respectively separated by line terminators and page terminators which are represented by control characters sequences.
As to line terminator, the user can choose between <CR> and <CR,LF> ASCII characters sequences, the one which is more appropriate to the file at issue. This selection can be performed through the FORM string when the file is opened or created (see [BIO]).

Page terminator is codified with the <FF> ASCII character.

Text files termination is identified because of the absence of additional characters to be read. This means that:

- Read operations beyond the end of text files recorded on memory devices (disks, tapes, etc.) raise ENDERROR exception.

- Read operations addressed to communication lines - whose drivers do

not generate any signaling, for the communication session closing - stop the application.

11.1.4 File Ada Objects Accessibility Criteria

It is necessary to observe that the piece of information output towards a Mara file created by an Ada program is correctly interpreted when read only if the following conditions are valid:

a) Use the same file model as the one adopted for writing;

b) As to generic models, instantiate with the same types as the ones used for writing;

c) For unconstrained writing types, readings must operate regularly with the same constraints .

Exceptions to rule b) are possible if SEQUENTIAL_IO and DIRECT_IO are used. In this case, the particular recording choice allows a direct, or sequential access to single files positions which are respectively sequential, or direct.

Obviously, these rules can be ignored when there is a total knowledge of types representation. In this case, however, a reading operated in terms of bytes, even if it is onerous, is realizable. It could be the case of the check of files produced by non Ada programs, or by Ada programs generated by language implementations which are different from the one used for the reader programming.

11.1.5 External Files Name - [NAME]

NAME parameter defined by any CREATE or OPEN primitives has to report a valid MARA path name.

Names indicating non-existent, or somehow illegal path servers cause an appropriate exception raising.

Ada Temporary Files (see [LRM] ch. 14.2.1) associated to name parameter null string, are associed to MARA File System work files. As a consequence, they are codified with the :FMS:* string.

USE_ERROR exception is raised by NAME function invoking for an Ada temporary file .

11.1.6 Operating Modes On External Files - [FORM]

FORM parameter in CREATE and OPEN subprograms has been used by the implementation in order to express a set of exchange modes which characterize MARA files transfers.

The form string has the following sytax:

```
<form_parameter>      ::=     <form_modality>  {,<form_modality>}
<form_modality>       ::=     <positive_form_modality>
                            | <negative_form_modality>


<positive_form_modality>      ::=
                    LINE_FOLDED
                    LINE_EDIT
                    DOUBLE_BUFFER
                    ECHO
                    TIMED
                    FULL_DUPLEX
                    TERMINATOR
                    SHARE_IN
                    SHARE_OUT
                    SHARE_INOUT


<negative_form_modality>   ::=  NO <positive_form_modality>
```

USE_ERROR exception is raised if FORM string does not observes this syntax.

Modes expressed in small letters are considered as illegal.

The various operating modes which can be expressed through the form string, and the relative implementation behaviour are listed below.

11.1.6.1 Line Folding

It allows to select the line terminator coding.

It is feasible with the FORM string [NO]LINE_FOLDED option.

NOLINE_FOLDED value codifies the line terminator with <ASCII.CR> control character.

LINE_FOLDED value codifies the line terminator with <ASCII.CR,ASCII.LF> control characters sequence.

11.1.6.2 Line Editing Mode

It allows the activation of the line editing as it is defined in [SDD] for input modes. In addition, it allows the activation of page terminator recognition codified by the implementation with the Form Feed control character which corresponds to <ASCII.FF> code.
It is feasible with [NO]LINE_EDIT option.

LINE_EDIT value activates the SDD line edit , and deactivates the page terminator recognition. NOLINE_EDIT value activates the page terminator recognition, and disactivates the SDD line editing .

In LINE_EDIT mode the input requests are terminated by line terminator acknowledge. The TEXT_IO.SKIP_PAGE send the USE_ERROR exception and "a page terminator never immediately follows a line terminator" is assumed by the TEXT_IO.SKIP_LINE subprogram.

11.1.6.3 Character Echo

It allows the programming of the SDD driver for echo mode as it is described in [SDD].

It is feasible through [NO]ECHO option.

11.1.6.4 Line Terminator

It allows the programming of the SDD driver for line terminator recognition.

It is feasible through [NO]TERMINATOR option.

11.1.6.5 Character Full Duplex Exchange

It allows the programming of the SDD driver to exchange a character in full duplex.

It is feasible through [NO]FULL_DUPLEX option.

FULL_DUPLEX option allows the output of one byte at most without interrupting any read operations in progress.

11.1.6.6 Double Buffer Exchange Mode

It allows to uncouple exchange cycles at the two sides of the path associated to the file by using two buffers which support the exchange.

It is feasible through [NO]DOUBLE_BUFFER option.

These buffers size is a parameter of the static implementation configuration, and acts at node level.

11.1.6.7 External Files Sharing

It allows to specify what reading, writing, and updating modes can be shared with the mode expressed by CREATE and OPEN subprograms MODE parameter.

It is feasible through [NO]SHARE_IN, [NO]SHARE_OUT, and [NO]SHARE_INOUT options.
It must be observed that this external file sharing control involves various FILE_TYPE objects use. These options have no effect on contemporary accesses performed by various tasks to the external file

through the exclusive use of a single file type object. As to this second problem, refer to Transportability notes section in this paper.

An external file sharing, if it is not appropriately controlled, can cause an unexpected sequencing of objects values stored in the file. This is not necessarily a problem when this sequencing is unessential (teletypes). On the other hand, it can be disastrous when a particular piece of information position in the file is the access key to the piece of information itself. As a consequence, a more careful use of the FORM string compared with sharing options use is recommended.

11.1.6.8 Path Time Out

It allows to limit the waiting time related to OPEN and CREATE files requests to the time value specified in BASIC_IO_CONFIGURATION package, i.e., to system default.

It is feasible through [NO]TIMED option.

Files whose access has been NOTIMED required, will activate a null waiting.

- NOTE: Waiting time control on OPEN and CREATE requests exclusively operates on Attach and Create path requests addressed to path manager (see [KER]). Any waiting on the following path open request is not included in waiting time required.

Waiting time handling on the path open depends on the path server involved. Consequently, refer to the relative Mara documents.

The USE_ERROR exception is raised at time-out expired when a non condivisible file access is attempt. The non condivisible condition is imposed by previous access.

The USE_ERROR exception is raised also when a non multiuser path server managed device access is attempt.

The DEVICE_ERROR exception is raised in all other cases.

11.2 TEXT_IO Standard Devices Control

Implementation associates TEXT_IO.STANDARD_OUTPUT and TEXT_IO. STANDARD_INPUT to MARA files defined respectively by :CO: and :CI: logic names. The relative physical name are required to the operating system by means of ProcessParms primitive invoking (see [KER] Process Management). This primitive returns to any parameters egment passed by the activator agent in which these names will be compiled in accordance with the modes described in [SPI].

The parameters buffer organization adopted by the implementation is the following:

```
type path_name is new plm_string;

type process_buffer is
record
reserved      :   path_manager_header;
prog_id       :   unsignedword;
spi_buf_id_1  :   byte;
spi_buf_id_2  :   byte;
ci_name       :   path_name;
lp_name       :   path_name;
co_name       :   path_name;
spi_buf_fac   :   byte;
console_info  :   plm_string;
end;
```

PATH_NAME fields are organized in the memory as PLM-286 strings (see [PLM]). The implementation interpretates these fields in the succession previously mentioned. Thus, these fields position is essential in order to associate correctly the path names to the relative standard devices.

Spi_buf_id_1 and spibufid2 fields identify the process buffer type. At present, only the buffer identified by the couple OFFH, 1 (or 9) - which has the structure above shown - is supported.

Spi_buf_fac field is not used, but it must be always present. It fills 8 successive memory bits (byte PLM-286).

CONSOLE_INFO field is optional, and can be used to define again :CI: and :CO: values, and to define the values which must be associated to the two :FI: and :FO: strings that, in every respect, are the two logic names of :CI: and :CO: format strings.

This field is a PLM string whose first byte reports - as a consequence - the number of following characters included in the string. The following characters sequence must observe the syntax below:

```
<console_info>    ::=              [  <stuff>  ]
          - <console_token>  { - <console_token> }
          <terminator>

<stuff>   ::=          <sequence_of_char>

<console token>        ::=              :CI:=   <sequence_of_char>
          |    :CO:=   <sequence_of_char>
          |    :FI:=   <sequence_of_char>
          |    :FO:=   <sequence_of_char>

<sequence_of_char>         ::=         <ascii_character>        (
<ascii_character>  )

<terminator>           ::=          ascii.cr  ascii.lf
```

Mutual position of the various tokens is not essential. If a token is present more times, the last instance is the one considered. The first token is found immediatly after the first - met. Whatever follows = until the next - , or at the end o the line, is considered part of a <sequence_of_char>.

It is the Ada program activator agent to compile such information in the parameters segment, and pass it then to application according to modes described in [KER] program loader.

In case Mini Session Monitor (see [MSM]) is an Ada program activator agent, CONSOLE_INFO field reports, according to described modes, command tail which accompanies program activation request. Such field can be used, therefore, to redefine path names associated to :CI: AND :CO: and relative form string.

CONSOLE_INFO field absence in the parameters segment associates to :FI: and :FO: form string, system
values defined through BASIC_IO generic package.

The absence of parameters segment or its erroneous compilation cause NAME_ERROR exception to be raised.

Such exception is handled during TEXT_IO package processing allowing program processing continuation. In such circumstances the use of subprograms operating on default files cause STATUS_ERROR exception to be raised. Consequently, the use of DEFAUL_DEVICES generic package is recommended which
allows to associate, to default devices, devices or files defined by the user.

Some examples of Ada programs invocation operated through Mini Session Monitor follow.

```
-     MY.LTL          -:CI:=:FMS:MARALAB/COMMAND.CCC-:FI:=NOSHARE_OUT
-     YOUR.LTL    -:FI:=SHARE_OUT-:FO:=NOTIMED
```

MY.LTL invocation addresses TEXT_IO.STANDARD_INPUT to :FMS:MARALAB/COMMAND.CCC. file Form string for such input prevents TEXT_IO.OUT_FILE mode application on such file. TEXT_IO.STANDARD_OUTPUT will be defined by Mini Session Monitor policies, while the relative form string is defined by current system default through generic BASIC_IO.

YOUR.LTL invocation allows to share output on the path associated by MSM to :CI:, and not to require path timeout for access to :CI:. Such paths are defined by MSM policies, and they typically coincide with the terminal from which program activation is required.

11.3 I/O Package Specifications

The specifications of the standard I/O packages follow:

11.3.1 IO_EXCEPTIONS

```
------------------------------------------------------------------------
------
--
--  Date          20 April 1983
--
--  Programmer    Peter Haff
--
--  Project       Portable Ada Programming System
--
--  Module        IO_EXCPS.ADA
--
--  Description   Specification of package IO_EXCEPTIONS.
--                RM  section 14.5.
--
--  Changes       Initial version 20 April 1983
--
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--
------------------------------------------------------------------------
------

pragma page;


package IO_EXCEPTIONS is

   -- The order of the following declarations must NOT be changed:

   STATUS_ERROR : exception;
   MODE_ERROR   : exception;
   NAME_ERROR   : exception;
   USE_ERROR    : exception;
   DEVICE_ERROR : exception;
   END_ERROR    : exception;
   DATA_ERROR   : exception;
   LAYOUT_ERROR : exception;

end IO_EXCEPTIONS;
```

11.3.2 BASIC_IO_TYPES

```
------------------------------------------------------------------------
-------------
--
```

```
--  Date          19 March 1986
--
--  Programmer    Knud Joergen Kirkegaard
--
--  Project       DDC Ada Compiler System
--                VAX-11 hosted
--
--  Module        BASIC_IO_TYPES (spec)
--
--  Description   Ada Input-Output System for VAX/VMS
--
--                Associated Documents:
--                DDC 5118/RPT/20, issue 2
--                DDC 118/RPT/13, issue 4
--
--                For Ada releases >= *.*
--
--
--  Changes       Initial version 19 March 1986
--
--  Copyright 1986 by Dansk Datamatik Center (DDC).
--  This program as well as any listing thereof may not
--  be reproduced in any form without prior permission
--  in writing from DDC.
--
-------------------------------------------------------------------
-------------

pragma page;
with system;

package basic_io_types is

   subtype io_kind is integer;

   -- io_kind is used in the create and open procedures and indicates:
   --          0 : sequential file
   --          1 : direct file
   --          2 : text file
   --           3 : variable file (this is not used by the standard
packages)

   type file_mode is range 0 .. 2;

   -- file_mode indicates the mode of the file:
   --          for sequential and text files:
   --              0 : in_file
   --              1 : out_file
   --
   --          for direct and variable files:
   --              0 : in_file
   --              1 : inout_file
   --              2 : out_file

   subtype key is long_integer;
```

```
   -- key is used by variable i/o to indicate the position in a file
   -- this may be implementation dependent

   type file_type is access integer;

   type count is range 0 .. long_integer'last;

   subtype positive_count is count range 1 .. count'last;

   subtype pointer is system.address;

   -- pointer is used in the read and write procedures to indicate a
data area

end basic_io_types;
```

11.3.3 TEXT_IO

```
------------------------------------------------------------------
-------------
--
--  Date          31 October 1983
--
--  Programmer    Soeren Prehn (, Knud Joergen Kirkegaard)
--
--  Project       Portable Ada Programming System
--                Input-Output
--
--  Module        TEXTIOS.ADA
--
--  Description   Specification of Package TEXT_IO,
--                Ada LRM (jan 83) 14.3.10
--
--  Changes       Initial version 31 October 1983
--                 Adapted to KAPSE interface specification 17 April
1986
--
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--
------------------------------------------------------------------
-------------

pragma page;
with BASIC_IO_TYPES;
```

```
with IO_EXCEPTIONS;
package TEXT_IO is

   type FILE_TYPE is limited private;

   type FILE_MODE is (IN_FILE, OUT_FILE);

   type    COUNT is range 0 .. LONG_INTEGER'LAST;
   subtype POSITIVE_COUNT is COUNT range 1 .. COUNT'LAST;
   UNBOUNDED: constant COUNT:= 0; -- line and page length

   subtype FIELD          is INTEGER range 0 .. 67; -- max. size of
an integer output field
                                                    -- 2#....#
   subtype NUMBER_BASE    is INTEGER range 2 .. 16;

   type TYPE_SET is (LOWER_CASE, UPPER_CASE);

pragma PAGE;
   -- File Management

     procedure CREATE (FILE   : in out FILE_TYPE;
                       MODE   : in     FILE_MODE := OUT_FILE;
                       NAME   : in     STRING    := "";
                       FORM   : in     STRING    := ""
                      );

     procedure OPEN   (FILE   : in out FILE_TYPE;
                       MODE   : in     FILE_MODE;
                       NAME   : in     STRING;
                       FORM   : in     STRING    := ""
                      );

   procedure CLOSE  (FILE   : in out FILE_TYPE);
   procedure DELETE (FILE   : in out FILE_TYPE);
   procedure RESET  (FILE   : in out FILE_TYPE; MODE  : in FILE_MODE);
   procedure RESET  (FILE   : in out FILE_TYPE);

   function  MODE   (FILE   : in FILE_TYPE) return FILE_MODE;
   function  NAME   (FILE   : in FILE_TYPE) return STRING;
   function  FORM   (FILE   : in FILE_TYPE) return STRING;

   function  IS_OPEN(FILE   : in FILE_TYPE) return BOOLEAN;

pragma PAGE;
   -- Control of default input and output files

   procedure  SET_INPUT    (FILE : in FILE_TYPE);
   procedure  SET_OUTPUT   (FILE : in FILE_TYPE);

   function   STANDARD_INPUT   return FILE_TYPE;
   function   STANDARD_OUTPUT  return FILE_TYPE;

   function   CURRENT_INPUT    return FILE_TYPE;
   function   CURRENT_OUTPUT   return FILE_TYPE;
```

```
pragma PAGE;
   -- specification of line and page lengths

   procedure SET_LINE_LENGTH  (FILE : in FILE_TYPE; TO : in COUNT);
   procedure SET_LINE_LENGTH  (TO : in COUNT);

   procedure SET_PAGE_LENGTH  (FILE : in FILE_TYPE; TO : in COUNT);
   procedure SET_PAGE_LENGTH  (                     TO : in COUNT);

   function  LINE_LENGTH      (FILE : in FILE_TYPE) return COUNT;
   function  LINE_LENGTH                            return COUNT;

   function  PAGE_LENGTH      (FILE : in FILE_TYPE) return COUNT;
   function  PAGE_LENGTH                            return COUNT;

pragma PAGE;
   -- Column, Line, and Page Control

     procedure  NEW_LINE       (FILE  :  in  FILE_TYPE;  SPACING  :  in
POSITIVE_COUNT := 1);
     procedure NEW_LINE     (                          SPACING : in
POSITIVE_COUNT := 1);

     procedure  SKIP_LINE      (FILE  :  in  FILE_TYPE;  SPACING  :  in
POSITIVE_COUNT := 1);
     procedure SKIP_LINE    (                          SPACING : in
POSITIVE_COUNT := 1);

     function  END_OF_LINE (FILE : in FILE_TYPE) return BOOLEAN;
     function  END_OF_LINE                       return BOOLEAN;

     procedure NEW_PAGE    (FILE : in FILE_TYPE);
     procedure NEW_PAGE                         ;

     procedure SKIP_PAGE   (FILE : in FILE_TYPE);
     procedure SKIP_PAGE                        ;

     function  END_OF_PAGE (FILE : in FILE_TYPE) return BOOLEAN;
     function  END_OF_PAGE                       return BOOLEAN;

     function  END_OF_FILE (FILE : in FILE_TYPE) return BOOLEAN;
     function  END_OF_FILE                       return BOOLEAN;

     procedure  SET_COL          (FILE  :  in  FILE_TYPE;  TO  :  in
POSITIVE_COUNT);
     procedure SET_COL       (                              TO : in
POSITIVE_COUNT);

     procedure  SET_LINE         (FILE  :  in  FILE_TYPE;  TO  :  in
POSITIVE_COUNT);
     procedure SET_LINE      (                              TO : in
POSITIVE_COUNT);

     function    COL                (FILE  :  in  FILE_TYPE)  return
POSITIVE_COUNT;
     function   COL                                           return
```

```
POSITIVE_COUNT;

     function    LINE                    (FILE  :  in  FILE_TYPE)  return
POSITIVE_COUNT;
     function   LINE                                                  return
POSITIVE_COUNT;

     function    PAGE                    (FILE  :  in  FILE_TYPE)  return
POSITIVE_COUNT;
     function   PAGE                                                  return
POSITIVE_COUNT;

pragma PAGE;
   -- Character Input-Output

   procedure GET   (FILE : in FILE_TYPE; ITEM : out CHARACTER);
   procedure GET   (                     ITEM : out CHARACTER);
   procedure PUT   (FILE : in FILE_TYPE; ITEM :  in CHARACTER);
   procedure PUT   (                     ITEM :  in CHARACTER);

   -- String Input-Output

   procedure GET   (FILE : in FILE_TYPE; ITEM : out STRING);
   procedure GET   (                     ITEM : out STRING);
   procedure PUT   (FILE : in FILE_TYPE; ITEM :  in STRING);
   procedure PUT   (                     ITEM :  in STRING);

   procedure GET_LINE  (FILE : in FILE_TYPE; ITEM : out STRING; LAST
: out NATURAL);
   procedure GET_LINE  (                     ITEM : out STRING; LAST
: out NATURAL);
   procedure PUT_LINE  (FILE : in FILE_TYPE; ITEM :  in STRING);
   procedure PUT_LINE  (                     ITEM :  in STRING);


pragma PAGE;
   -- Generic Package for Input-Output of Integer Types

  generic
     type NUM is range <>;
  package INTEGER_IO is

     DEFAULT_WIDTH : FIELD         := NUM'WIDTH;
     DEFAULT_BASE  : NUMBER_BASE   :=        10;

     procedure GET   (FILE  :  in FILE_TYPE; ITEM : out NUM; WIDTH :
in FIELD := 0);
     procedure GET   (                       ITEM : out NUM; WIDTH :
in FIELD := 0);

     procedure PUT   (FILE  :  in FILE_TYPE;
                      ITEM  :  in NUM;
                      WIDTH :  in FIELD := DEFAULT_WIDTH;
                      BASE  :  in NUMBER_BASE := DEFAULT_BASE);
     procedure PUT   (ITEM  :  in NUM;
                      WIDTH :  in FIELD := DEFAULT_WIDTH;
```

```
                        BASE   :  in NUMBER_BASE := DEFAULT_BASE);

     procedure GET  (FROM  : in STRING; ITEM : out NUM; LAST : out
POSITIVE);
     procedure PUT  (TO    : out STRING;
                     ITEM  :  in NUM;
                     BASE  :  in NUMBER_BASE := DEFAULT_BASE);

  end INTEGER_IO;

pragma PAGE;
   -- Generic Packages for Input-Output of Real Types

generic
   type NUM is digits <>;
package FLOAT_IO is

   DEFAULT_FORE : FIELD :=               2;
   DEFAULT_AFT  : FIELD := NUM'DIGITS - 1;
   DEFAULT_EXP  : FIELD :=               3;

   procedure GET  (FILE : in FILE_TYPE; ITEM : out NUM; WIDTH : in
FIELD := 0);
   procedure GET  (                     ITEM : out NUM; WIDTH : in
FIELD := 0);

   procedure PUT  (FILE : in FILE_TYPE;
                   ITEM : in NUM;
                   FORE : in FIELD := DEFAULT_FORE;
                   AFT  : in FIELD := DEFAULT_AFT;
                   EXP  : in FIELD := DEFAULT_EXP);
   procedure PUT  (ITEM : in NUM;
                   FORE : in FIELD := DEFAULT_FORE;
                   AFT  : in FIELD := DEFAULT_AFT;
                   EXP  : in FIELD := DEFAULT_EXP);

   procedure GET  (FROM : in STRING; ITEM : out NUM; LAST : out
POSITIVE);
   procedure PUT  (TO   : out STRING;
                   ITEM :  in NUM;
                   AFT  :  in FIELD := DEFAULT_AFT;
                   EXP  :  in FIELD := DEFAULT_EXP);

end FLOAT_IO;

pragma PAGE;
generic
   type NUM is delta <>;
package FIXED_IO is

   DEFAULT_FORE : FIELD := NUM'FORE;
   DEFAULT_AFT  : FIELD := NUM'AFT;
   DEFAULT_EXP  : FIELD := 0;

   procedure GET  (FILE : in FILE_TYPE; ITEM : out NUM; WIDTH : in
FIELD := 0);
```

```
   procedure GET   (                          ITEM : out NUM; WIDTH : in
FIELD := 0);

   procedure PUT   (FILE : in FILE_TYPE;
                    ITEM : in NUM;
                    FORE : in FIELD := DEFAULT_FORE;
                    AFT  : in FIELD := DEFAULT_AFT;
                    EXP  : in FIELD := DEFAULT_EXP);

   procedure PUT   (ITEM : in NUM;
                    FORE : in FIELD := DEFAULT_FORE;
                    AFT  : in FIELD := DEFAULT_AFT;
                    EXP  : in FIELD := DEFAULT_EXP);

   procedure GET   (FROM : in STRING; ITEM : out NUM; LAST : out
POSITIVE);
   procedure PUT   (TO   : out STRING;
                    ITEM :  in NUM;
                    AFT  :  in FIELD := DEFAULT_AFT;
                    EXP  :  in FIELD := DEFAULT_EXP);

end FIXED_IO;

pragma PAGE;
   -- Generic Package for Input-Output of Enumeration Types

generic
   type ENUM is (<>);
package ENUMERATION_IO is

   DEFAULT_WIDTH   : FIELD    := 0;
   DEFAULT_SETTING : TYPE_SET := UPPER_CASE;

   procedure GET   (FILE : in FILE_TYPE; ITEM : out ENUM);
   procedure GET   (                     ITEM : out ENUM);

   procedure PUT   (FILE  : in FILE_TYPE;
                    ITEM  : in ENUM;
                    WIDTH : in FIELD      := DEFAULT_WIDTH;
                    SET   : in TYPE_SET   := DEFAULT_SETTING);

   procedure PUT   (ITEM  : in ENUM;
                    WIDTH : in FIELD      := DEFAULT_WIDTH;
                    SET   : in TYPE_SET   := DEFAULT_SETTING);

   procedure GET   (FROM : in  STRING; ITEM : out ENUM; LAST : out
POSITIVE);
   procedure PUT   (TO   : out STRING;
                    ITEM : in  ENUM;
                    SET  : in  TYPE_SET := DEFAULT_SETTING);

end ENUMERATION_IO;

pragma PAGE;
   -- Exceptions
```

```
   STATUS_ERROR : exception renames IO_EXCEPTIONS.STATUS_ERROR;
   MODE_ERROR   : exception renames IO_EXCEPTIONS.MODE_ERROR;
   NAME_ERROR   : exception renames IO_EXCEPTIONS.NAME_ERROR;
   USE_ERROR    : exception renames IO_EXCEPTIONS.USE_ERROR;
   DEVICE_ERROR : exception renames IO_EXCEPTIONS.DEVICE_ERROR;
   END_ERROR    : exception renames IO_EXCEPTIONS.END_ERROR;
   DATA_ERROR   : exception renames IO_EXCEPTIONS.DATA_ERROR;
   LAYOUT_ERROR : exception renames IO_EXCEPTIONS.LAYOUT_ERROR;

pragma page;
private


   type FILE_BLOCK_TYPE is new BASIC_IO_TYPES.FILE_TYPE;

   type FILE_OBJECT_TYPE is
      record
         IS_OPEN    : BOOLEAN          := FALSE;
         FILE_BLOCK : FILE_BLOCK_TYPE;
      end record;

   type FILE_TYPE is access FILE_OBJECT_TYPE;

end TEXT_IO;
```

11.3.4 SEQUENTIAL_IO

```
------------------------------------------------------------------
------
--
--  Date          20 April 1983
--
--  Programmer    Peter Haff (, Soeren Prehn, Knud Joergen Kirkegaard)
--
--  Project       Portable Ada Programming System
--
--  Module        SEQIOS.ADA
--
--  Description   Specification of package SEQUENTIAL_IO.
--                LRM (Jan 83) section 14.2.3
--
--  Changes       Initial version 20 April 1983
--
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--
```

```
------------------------------------------------------------------------
------

pragma PAGE;

with IO_EXCEPTIONS;
with BASIC_IO_TYPES;

generic

   type ELEMENT_TYPE is private;

package SEQUENTIAL_IO is

  type FILE_TYPE is limited private;

  type FILE_MODE is (IN_FILE, OUT_FILE);


pragma PAGE;
-- File management

   procedure CREATE(FILE : in out FILE_TYPE;
                    MODE : in     FILE_MODE := OUT_FILE;
                    NAME : in     STRING    := "";
                    FORM : in     STRING    := "");

   procedure OPEN  (FILE : in out FILE_TYPE;
                    MODE : in     FILE_MODE;
                    NAME : in     STRING;
                    FORM : in     STRING := "");

   procedure CLOSE (FILE : in out FILE_TYPE);

   procedure DELETE(FILE : in out FILE_TYPE);

   procedure RESET (FILE : in out FILE_TYPE;
                    MODE : in     FILE_MODE);

   procedure RESET (FILE : in out FILE_TYPE);

   function MODE   (FILE : in FILE_TYPE) return FILE_MODE;

   function NAME   (FILE : in FILE_TYPE) return STRING;

   function FORM   (FILE : in FILE_TYPE) return STRING;

   function IS_OPEN(FILE : in FILE_TYPE) return BOOLEAN;


pragma PAGE;
-- input and output operations


   procedure READ  (FILE : in     FILE_TYPE;
                    ITEM :    out ELEMENT_TYPE);
```

```
   procedure WRITE (FILE : in FILE_TYPE;
                    ITEM : in ELEMENT_TYPE);

   function END_OF_FILE(FILE : in FILE_TYPE) return BOOLEAN;


pragma PAGE;
-- exceptions


   STATUS_ERROR : exception renames IO_EXCEPTIONS.STATUS_ERROR;
   MODE_ERROR   : exception renames IO_EXCEPTIONS.MODE_ERROR;
   NAME_ERROR   : exception renames IO_EXCEPTIONS.NAME_ERROR;
   USE_ERROR    : exception renames IO_EXCEPTIONS.USE_ERROR;
   DEVICE_ERROR : exception renames     IO_EXCEPTIONS.DEVICE_ERROR;
   END_ERROR    : exception renames IO_EXCEPTIONS.END_ERROR;
   DATA_ERROR   : exception renames IO_EXCEPTIONS.DATA_ERROR;

pragma PAGE;
private

   type FILE_TYPE is new BASIC_IO_TYPES.FILE_TYPE;

end SEQUENTIAL_IO;
```

11.3.5 DIRECT_IO

```
------------------------------------------------------------------
------
--
--  Date          20 April 1983
--
--  Programmer    Peter Haff (,Soeren Prehn, Knud Joergen Kirkegaard)
--
--  Project       Portable Ada Programming System
--
--  Module        DIR_IO.ADA
--
--  Description   Specification of package DIRECT_IO.
--                LRM (jan 83) section 14.2.5.
--
--  Changes       Initial version 20 April 1983
--          31 OCT 1983: FILE_TYPE made private. /SP
--                       21 March 1986: Adapted to KAPSE interface
specification.
--
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```

```
--
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--
-------------------------------------------------------------------
------

pragma PAGE;
with IO_EXCEPTIONS;
with BASIC_IO_TYPES;

generic

   type ELEMENT_TYPE is private;

package DIRECT_IO is


   type FILE_TYPE is limited private;

   type FILE_MODE is (IN_FILE, INOUT_FILE, OUT_FILE);

   type COUNT is range 0..LONG_INTEGER'LAST;
   subtype POSITIVE_COUNT is COUNT range 1..COUNT'LAST;


pragma PAGE;
-- File management

   procedure CREATE(FILE : in out FILE_TYPE;
                    MODE : in     FILE_MODE  := INOUT_FILE;
                    NAME : in     STRING     := "";
                    FORM : in     STRING     := "");

   procedure OPEN  (FILE : in out FILE_TYPE;
                    MODE : in     FILE_MODE;
                    NAME : in     STRING;
                    FORM : in     STRING    := "");

   procedure CLOSE (FILE : in out FILE_TYPE);

   procedure DELETE(FILE : in out FILE_TYPE);

   procedure RESET (FILE : in out FILE_TYPE;
                    MODE : in     FILE_MODE);

   procedure RESET (FILE : in out FILE_TYPE);

   function MODE   (FILE : in FILE_TYPE) return FILE_MODE;

   function NAME   (FILE : in FILE_TYPE) return STRING;

   function FORM   (FILE : in FILE_TYPE) return STRING;

   function IS_OPEN(FILE : in FILE_TYPE) return BOOLEAN;
```

```
pragma PAGE;
-- input and output operations


   procedure READ  (FILE : in     FILE_TYPE;
                    ITEM :    out ELEMENT_TYPE;
                    FROM : in     POSITIVE_COUNT);
   procedure READ  (FILE : in     FILE_TYPE;
                    ITEM :    out ELEMENT_TYPE);

   procedure WRITE (FILE : in FILE_TYPE;
                    ITEM : in ELEMENT_TYPE;
                    TO   : in POSITIVE_COUNT);
   procedure WRITE (FILE : in FILE_TYPE;
                    ITEM : in ELEMENT_TYPE);

   procedure SET_INDEX(FILE : in FILE_TYPE;
                       TO   : in POSITIVE_COUNT);

   function INDEX(FILE : in FILE_TYPE) return POSITIVE_COUNT;

   function SIZE (FILE : in FILE_TYPE) return COUNT;

   function END_OF_FILE(FILE : in FILE_TYPE) return BOOLEAN;


pragma PAGE;
-- exceptions


   STATUS_ERROR : exception renames IO_EXCEPTIONS.STATUS_ERROR;
   MODE_ERROR   : exception renames IO_EXCEPTIONS.MODE_ERROR;
   NAME_ERROR   : exception renames IO_EXCEPTIONS.NAME_ERROR;
   USE_ERROR    : exception renames IO_EXCEPTIONS.USE_ERROR;
   DEVICE_ERROR : exception renames IO_EXCEPTIONS.DEVICE_ERROR;
   END_ERROR    : exception renames IO_EXCEPTIONS.END_ERROR;
   DATA_ERROR   : exception renames IO_EXCEPTIONS.DATA_ERROR;

pragma PAGE;
private

  type FILE_TYPE is new BASIC_IO_TYPES.FILE_TYPE;

end DIRECT_IO;
```

12 Basic I/O configurability

The present section lists configurability elements of Ada basic I/O support defined by BASIC_LEXICAL_IO, BASIC_TEXT_IO and BASIC_COMMON_IO packages (see [UserGuide]).

As basic I/O directly supports Ada standard I/O, configurabily features described here can be transitively transported to standard I/O context.

Support configurability concerns control of system resources committed for a Mara file access, as well as control of access modaes to a file expressed by FORM string (see [BIO]).

Both control types are feasible both at single program level and at system level. The latter acts as default for program level.

Program configurability is feasible through generic packages listed below. Such library units specification is reported in Appendix A.

System configurability is expressed both through SCL language, in ADABIO factory product
description (see [ADABIO]), and through the use of BASIC_IO generic package.

12.1 Program Configurability

Ada basic I/O support presents some configurability characteristics that application program can control using BASIC_IO_CONFIGURATION, DEFAULT_FORM and DEFAULT_DEVICES generic packages.

12.1.1 DEFAULT_DEVICES Generic Package

[...] details choices operated by the implementation in associating appropriate external files to TEXT_IO.STANDARD_INPUT and TEXT_IO.STANDARD_OUTPUT standard devices and therefore to default ones (see [LRM] ch 14.3]. In case system choices are not applicable, the user can provide new values to default devices through DEFAULT_DEVICES generic package.

Such values act at application program level. Other node programs are not influenced by the new choice.

```
with default_devices;
package my_devices is new default_devices (
output_name                    =>     :D:0007 ,
input_name                     =>     :D:0007 ,
input_form                     =>     SHARE_OUT ,
output_form                    =>     NOTIMED);
with my_devices;
procedure my_program is ... end;
```

The example shows a possible use of such generic, operated at program library level.

After instantiation of such package has been processed, :D:0007 path name refers to device to be used as current default input and current default output . As regards input form string, it is allowed to share output mode. As regards output form string, a null wait is required on relative attach path request.

If such package is istantiated more times within a program, effective choice will depend on processing order fixed by compiler and linker of the various instantiations (see [LRM] ch. 10), according to

programmed
dependence between the various program units.

NOTE: The use of such generic is useful only when TEXT_IO.STANDARD_INPUT and TEXT_IO.STANDARD_OUTPUT correspond to no external file. This occurs in case of absence or erroneous compilation of parameters segment passed to an Ada application main program by environment agent that this activates.

DEFAULT_DEVICES instantiation in presence of parameters segment, corresponds to a no operation to the full.

In other terms, DEFAULT_DEVICES:

- prevents TEXT_IO.STANDARD_INPUT and TEXT_IO.STANDARD_OUTPUT modification. These files are always associated to :CI: and :CO:, whatever their value is;

--- prevents TEXT_IO.CURRENT_INPUT and TEXT_IO.CURRENT_OUTPUT redirection on new default values whenever current defaults are associated to some external file.

If TEXT_IO.CURRENT_INPUT and TEXT_IO.CURRENT_OUTPUT redirection is needed, you are invited to use TEXT_IO relative subprograms explicitly.

12.1.2 DEFAULT_FORM Generic Package

An application user can arrange default values limited by program context through DEFAULT_FORM generic package use.

```
with default_form;
package  my_form is new default_form (        DOUBLE_BUFFER  &
 ,LINE_FOLDED  &
 ,NOLINE_EDIT  &
 ,SHARE_IN  &
 ,NOSHARE_OUT  &
 ,NOSHARE_INOUT  &
 ,ECHO  &
 ,TERMINATOR,  &
 ,TIMED );

with my_form:
procedure my_program is ... end;
```

The example shows a possible use of such generic, operated at program library level.

After such package instantiation has been processed, the indicated string value replaces previous values defined by previous instantiations, that is system ones.

If such package is instantiated more times within a program, effective

choice will depend on various instantiations processing order established by compiler and linker (see [LRM] ch. 10), according to programmed dependences between the various program units.

12.1.3 BASIC_IO_CONFIGURATION Generic Package

BASIC_IO_CONFIGURATION generic package allows to fix the following quantities in the program context:

- increase with respect to the current value of connections number to be operated towards external files: NUMBER_OF_FILES;

- time, expressed with CALENDAR.DAY_DURATION typology, you are ready to wait for on OPEN or CREATE requests to complete them: TIME_OUT.
- value of exchange buffers width on accessed files: BUFFER_SIZE.

```
with basic_io_configuration;
package my_configuration is basic_io_configuration (
buffer_size                          =>        3000;
time_out                             =>        120.0;
number_of_files;                     =>        15)
```

The example indicates to process with maximum 15 files which are opened contemporarily. As support memory to the fifteen connections is accorded by Kernel and paged up with 128 storageunits pages, and as connection unitary support is not commensurable with 128, it may occour that a higher number of files be actually opened.

To allocate necessary support memory, implementation adopts the minimum number of segments. Such segments are required together with those OPEN and CREATE requests which exhaust current segment.

New segments request is disabled beyond the limit declared by BASIC_IO_CONFIGURATION package instantiation. In this circumstance, STORAGE_ERROR exception is raised on request of extra-connections with respect to declared ones.

Segment unavailability causes STORAGE_ERROR exception to be raised even below the declared limit.

A careful use of such package allows to dimension memory segments width at best on grounds of requisites declared by an application program, though it does not ensure memory availability which is however necessary to support the number of required connections. So you are encouraged to use it !

The other parameters require a waiting time which does not exceed two minutes for each access request on a MARA file as well as a 3000 storage units wide exchange with buffer.

Processing order will decide which values will be active between one instantiation and the following, as for the other generic supports in case of multiple instantiations of such package.

Generic package specification does not provide default values. Therefore, it is necessary to define a complete triple for the three parameters on each instantiation, otherwise it is impossible to compile the instantiation.

12.2 Static Configurability

12.2.1 DATA clause

Though DATA clause of SCL description of support to Ada basic i/o (see [ADABIO]), it is possible to dimension default values for parameters defined by BASIC_IO_CONFIGURATION package.

```
DATA RTS.OBJ
    MAX_NUMBER_OF_FILES     =  WORD P_NUMBER$OF$FILES;
    MIN_TIME_OUT_LOW        =  WORD P_TIME$OUT$LOW;
    MIN_TIME_OUT_HIGH       =  WORD P_TIME$OUT$HIGH;
    SIZE_OF_BUFFERS         =  WORD P_BUFFER$SIZE;
END DATA;

. . .

INVOKE ADABIO  (13,0000,7H,2500) REPEATED;
```

The example shows a static configuration which will afford access to no more than 13 contemporary connections to MARA files for each program executed in the node. Each connection will be temporized for no more than 7 * 2 exp (16) microseconds. The buffers exchanged on each connection will be 2500 storageunits (word) wide.

The use of BASIC_IO_CONFIGURATION package allows to replace program defaults with system values expressed by DATA clause.

The following unitary commitment of system resources for dimensioning of P_NUMBEROFFILES parameter must be considered:

- 1 path;
- 2 path mailboxes;
- 1 + x path buffers with x in 1..2 according to single or double buffer operation;
- 1 about 70 local or nodal bytes + 22 nodal bytes;

Nodal bytes will be really such for nodes having nodal memory. On the contrary, they will be summed to those required by local memory.

12.2.2 BASIC_IO Generic Package

BASIC_IO generic package allows to configure ADABIO product with respect to form tail value, which must act as system dfault, and with respect to format tail value which must act for files referred by :CI: and :CO: logic names, to which implementation associates TEXT_IO.STANDARD_INPUT and TEXT_IO.STANDARD_OUTPUT.

```
with basic_io;
package fi_configuration is new basic_io;
```

```
with basic_io;
package user_configuration is new basic_io
  (form    =>  NODOUBLE_BUFFER  &
 ,LINE_FOLDED  &
 ,NOLINE_EDIT  &
 ,NOSHARE_IN  &
 NOSHARE_OUT  &
 ,NOSHARE_INOUT  &
 ,ECHO  &
 ,TERMINATOR  &
 ,TIMED  &
  ci-form      =>        NOSHARE_OUT ,
  co_form      =>        TIMED ):
```

In the first example, reconfiguration package configures basic_io support accepting generic default values (see app. A).

In the second case user_configuration package configures support, assigning, as system default, the following operating modalities:

- double buffer modality
- files will be line-editable
- their line terminator will be codified with <cr,lf),
- no sharing form will be possible,
- echo on input operations will be operated
- line and page terminator will be recognized
- access requests will be subdued to time out.

Once chosen configuration has been compiled, it can be installed in the node generating an Ada program on it, whose SCL specification describes an invoked type program (see [GENRP]).

An example of the system generation related to BASIC_IO configuration is described below.

Ada text, contained in NODAL_ELABORATION.ADA

```
with basic_io;
package fi_configuration is new basic_io;

with fi_configuration;
procedure nodal_elaboration is
begin
      null;
end;
```

SCL text, contained in MYSYS.SCL

```
. . .

program template Nodal_Elaboration large

code PRIVATE
data PRIVATE NODAL;

module                          :FMS:ADARTSA1/RTSDATA.OBJ      relocatable;
module                          :FMS:ADABIOA1/BIODATA.OBJ      relocatable;
module                          :NodalElaboration              relocatable;
module                          :FMS:DACS86A0/ROOT.LIB         relocatable;
module                          :FMS:DACS86A0/RTHELP286.LIB    relocatable;
module                          :FMS:KER286A0/ADAUS.LIB
relocatable;
module                          :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module                          :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module                          GATELBA                        relocatable;

initial procedure Nodal_Elaboration
stacksegment nodal size = 2000H;

  end program;

. . .

function ada_container
privilege                              2
function_segment      100
maxpriority                        7
initial program nodal_elaboration;

invoke nodal_elaboration;
invoke adabio repeated;

end function;

. . .
```

DCL text

```
  . . .

$     SCL 286 MYSYS.SCL

. . .

$     ADA286/LIBRARY   = MY_ALB.ALB  ADABIOA0:NODAL_ELABORATION.ADA
$     ASSIGN/NOLOG MYSYS.GRA  ADA286_GRAPH
$     ASSIGN/NOLOG  NODAL_ELABORATION.LNK  NODAL_ELABORATION
$     ADA286/LINK/LIBR    =MY_ALB.ALB/OFD=[     ]     /     TEMPLATE
NODAL_ELABORATION
. . .

$     GENIP MYSYS.GRA ASSIGN NODAL_ELABORATION=NODAL_ELABORATION.LTL
$     ABS286 MYSYS.IPL
. . .
```

Such command sequence will deposit NODAL_ELABORATION.LTL file in current directory, which together with the other programs described, will represent the system initial program.

During initialization phase, kernel initialization process will activate nodal_elaboration program, which has been declared function initial program in the present example.

At the end of this elaboration the function will be declared ready through a non visible call of SET_FUNCTION_READY kernel procedure. The continuation of system initialization is than possible.

12.3 Basic I/O Intrinsic Limits

Lexical elements reading requests through TEXT_IO generic subprograms cannot exceed 128 characters.

13 [BIO] INPUT OUTPUT HANDLING

13.1 Devices handled by SDD AND SDS

SDD and SDS (see [SDD],[SDS]) classify devices into three conventional classes:

- teletype;
- printer;

- video;

Teletype typology is used for host computers and terminals input and output connections.

Printer typology provides for host computers and printers only output connections.

Video typology provides for video terminals handling able to organize information according to predetermined masks.

Of the three devices classes, video class is the only one which cannot suitably correspond to any of the three standard models provided by the language.

Such limitation is essentially due to positional information organization on video device and to the typological variety of objects that can be exchanged with it. Textio and directio models mix seems to be therefore the best model to control conventional videos. To define such mix lies outside the scope of this document.

Both Ada text and Ada sequential files are useful to model the exchange with teletype and printer type interactive devices and host computers.

Independent of the file model chosen, various read options control towards conventional teletypes defined in [SDD] is feasible exclusively by using the following form string modes:

- [NO]TERMINATOR;
- [NO]LINE_EDIT;
- [NO]LINE_FOLDED;
- [NO]ECHO;
- [NO]DOUBLE_BUFFER;

In the following two sections some guide notes and examples are reported which allow to use form string for an interactive devices and host computers efficient control through Ada file standard models.

13.1.1 Interactive Devices

Ada text files are the most suitable and flexible model to control teletype and printer type devices connected respectively to terminals and physical printers.

Suitability depends on the nature of such devices exchanging an information which is structured in itself
on character basic typology in ASCII coding.

Flexibility depends on the presence of INTEGER_IO, EUMERATION_IO, FLOAT_IO and FIXED_IO packages which allow on the one hand to output

integer, enumerative and real type values in the ASCII format, that is directly interpreted by the device; on the other hand to input directly from the device integer, enumerative and real values, subdueing them to language lexical control.

Such flexibility is paid with less efficient exchanges with respect to exchanges based on more elementary character or string types. Anyway, exchanges of this kind compel to use less structured types and therefore less powerful operators, which finally lead to a less compact and therefore less efficient code.

A conventional teletype associated to an interactive device supports characters line concept, allowing to complete input operations to identify a terminating sequence defined during activation of associated peripheral device. Such performance is directly feasible through TERMINATOR modes in form string.

According to layout handling needs of a text file generated by an interactive device, implementation allows, through LINE_EDIT option (see [FORM]), to read towards SDD and SDS or in the so called line edit mode, or in transparent reading mode with terminator (see [SDD]).

In line edit mode, conventional teletypes are not able to generate text file layout, essentially for two reasons.

First because any control character generated by the device and different from those used to carry out
line edit functionalities, is removed from SDD driver. Ascii.ff character will never be brought back from SDD to an application software.

Secondly because of an automatic line scrolling operated on the last video device useful line with no signal interpretable as page closing corresponding to it in the device itself.

This implies that SKIPLINE service implementation, in such devices operated according to line edit modes, can omit actions relative to identifiaction of a possible page terminator immediatly following line terminator. This ensures a device wait limited to identification of line terminator alone.

If it is necessary to use an interactive device to generate a page text file, NOLINE_EDIT mode can be requested. In such mode, implementation reads towards device in transparent with terminator mode. In this situation, SKIP_LINE and SKIP_PAGE reactivate ascii.ff character identification, questioning the device for a further character after a line terminator in the case of SKIP_LINE, or of ascii.ff character in the case of SKIP_PAGE.NOTE.

Because of further activated waits, one can think that implementation behaviour is wrong. This is not true. Such behaviour is expected in this kind of input towards conventional teletypes which are interactive devices.

13.1.2 Connections Towards Host Computer

Both text files and sequential files can be used to control the input of a conventional teletype connected to a host computer.
Ada sequential files are the most suitable models to exchange with the outside in case character type
is not the base of the exchange.

As in the previous case, also in these circumstances input control is feasible through form string modes.

This implies to terminate these requests only when bytes number collected by the device is the same as the size of instantiated type binary representation.

Omitting identification of page terminator can be penalized when teletype characterization is used to handle serial communication lines connected to host computers. In these cases implementation allows to restore in SKIP_LINE page terminator recognition through FORM string LINE_EDIT qualifier (see Selectic· of external files attributes).

13.2 Devices Handled By Real Time Protocol

Not supported

13.3 Basic Types

In the STANDARD package, the following types are defined:

- INTEGER = on 16 bits, its range is -32768..32767

- LONG_INTEGER = on 32 bits, its range is -2147483648..2147483647

From the point of view of the admitted values range, to these types respectively correspond - in Ada/Digital - the types:

· SHORT_INTEGER
· INTEGER

For this reason, it would be better not to use standard definitions but to define some new types which are made to correspond to equal representations in the two implementations; what said can be extended to NATURAL and POSITIVE subtypes.

Predefined types FLOAT and LONG_FLOAT are represented respectively with 6 digits on 32 bits and with 15 digits on 64 bits.

This representation coincides to the ADA/Digital one for the types with the same name.

To obtain the transportability on MARA, in Ada/Digital you must not use:

- the LONG_LONG_FLOAT type (33 digits on 128 bits) which has not an equivalent in our compiler

- the LONG_FLOAT pragma which originates a different representation for LONG_FLOAT objects (15 digits on 64 bits)

The generic FLOAT_MATH_LIB ([MATH]) package which is present at the first level of Mara program library, can be implemented with FLOAT, LONG_FLOAT types or with types derived from them.

In conclusion, to assure the transportability between these two systems, it is advisable to define and use the following BASIC_TYPES package:

```
package BASIC_TYPES is

    type  INTEGER_16      is new INTEGER;                    - - For
DDC
    type  INTEGER_32  is new LONG_INTEGER;                 - - For DDC
- -     type  INTEGER_16      is new SHORT_INTEGER;          - - For DEC
- -     type  INTEGER_32      is new INTEGER;                - - For DEC

    subtype NATURAL_16        is INTEGER_16 range 0..INTEGER_16LAST;
    subtype NATURAL_32        is INTEGER_32 range 0..INTEGER_32LAST;

    subtype POSITIVE_16       is INTEGER_16 range 1..INTEGER_16LAST;
    subtype POSITIVE_32       is INTEGER_32 range 1..INTEGER_32LAST;

    type FLOAT_32             is new FLOAT;                  - - For
DEC & DDC
    type FLOAT_64             is new LONG_FLOAT;

end BASIC_TYPES;
```

However, it is recommended to do no assumption on how a certain type (particularly if complex) of objects are memory represented, and, if needed, to resort to explicit representation clauses.

13.4 Ada/DDC programs sementing.

An Ada/DDC program may have a certain number of associated data-segments, each if them corresponding to a program-library level. Objects declared in a library package or in a package that, in any case, is not contained in a subprogram declaration (but in another package) and which are at that library level take up room in a data-segment of a given level.

The maximum dimension of each data-segment is 64 k-bytes; this value imposes a limit to the quantity and to the dimension of the objects which are allocated in it.

We define as library tasks the tasks whose declaration (in case of the only type) immediately appears inside a library package, or inside a package which is directly inside a library package and so on; after a point of this type is defined as a 0 level point.

To each of these tasks, a memory segment is dynamically associated; in this segment, this task stack is allocated togheter with the stacks of all the others tasks depending on it ([LRM 83], par. 9.4).

The main-task handling is similar to that of library tasks.

The dimension of the memory segment associated to the main-task is fixed to the moment of the program generation by means of the stacksegment size SCL directive ([SCL]). On the contrary, for a library task it can be fixed by means of the SET_CHILD_SEGMENT_SIZE function recall ([APX A - ADA_RTS]);

In case of lack of this one, the dimension of the task segment processing its declaration, or performing its dynamic allocation is used (through new).

The stack dimension of a task can be fixed by means of a length clause ([LRM 83], par. 13.2); and the main-task one through the option provided by the linker ([CLU], par. 3).

Obviously, the dimension of a segment associated to a library task must be large enough to contain the stack of this task and those of the tasks depending on it. If in the segment there is no room for the stack of the nth task, the TASKING-ERROR exception is raised ([LRM 83], par. 9.3).

Also for each of these segments, the maximum dimension is 64 k-bytes.

As tasks handling in Ada/Digital is completely different, this exception handling is recommended in order to easily detect the cause of different behaviours in applications brought from VAX to Mara.

As to the code, the dimension of a single compilation unit segment cannot exceed 32 k-bytes; see also, ([Users guide] par. 6.1.1) what about the clusterization of the code coming from different compilation units.

It must be taken into account that Mara Software Factory tools imply that a program occupies a maximum of 255 memory segments, code and data included; thus, in case of Ada programs, the segments containing the tasks stacks must not be counted.
Finally, see ([Users guide] par. 9.6) what about the way in which the compiler associates declarative items to different memory areas.

13.5 Shared variables.

Ada permits the use of shared variables, i.e. variables simultaneously accessible to various tasks. Note that the variables declared in a package body are not visible but they can be still shared by package procedures; thus, an indirect access to them is possible by various

tasks.
A compiler is allowed to make the two following assumptions ([LRM 83], par. 9.11):

- if between two synchronization points a task reads a scalar or access type shared variable, then the variable is modified by no other task in a moment between these two points.

- if between two synchronization points a task modifies a scalar or access type shared variable, then the variable is either read or modified by no other task in a moment between these two points.

A program violating the previous assumptions is formally wrong. May be that its execution is correct, but it isnt any more if the compiler or simply the optimization is changed.

In fact, their application is permitted also when shared variables are involved; thus, a compiler can maintain their value in a register instead of updating it continuously in memory. The only guarantee that the compiler must provide is that the variable is actually updated when a synchronization point is reached, and that after this point a copy - for instance contained in a register - is not used.

No assumption can be done by a programmer on not mentioned type shared variables handling. In particular, on FILE_TYPE objects (which are limited private), two tasks can have no consistency guarantee. In case of sharing, a solution can be that of defining a task which - being the only authorized one - accesses to I/O services and exports their specification with as many tasks entries.

For a compact management of the problem, in case of SEQUENTIAL_IO, the SYNCRONIZED_SEQUENTIAL_IO package reported below can be used as a trace; the same solution can be adopted for the generic DIRECT_IO package and for the non-generic TEXT_IO one.

```
with sequential_io; use sequential_io;
with io_exceptions;

generic
type element_type is private;

package synchronized_sequential_io

    procedure create (   file     :   in out file_type;
        mode       :   in file_mode    := out_file;
        name       :   string       :=   ;
        form       :   string       :=   );

procedure read      ( file         :   in    file_type;
        item       :   out   element_type);
private

end synchronized_sequential_io;

package body synchronized_sequential_io is
```

```
task synchronize is

entry create (    file     :   in out file_type;
         mode     :   in file_mode    := out_file;
         name     :   string          :=   ;
         form     :   string          :=   );


entry read ( file         :   in    file_type;
         item     :   out   element_type);

end synchronize;

procedure create (    file     :   in out file_type;
         mode         :   in file_mode    := out_file;
         name         :   string      :=   ;
         form         :   string      :=   ) is
  begin
      synchronize.create(file,mode,name,form);
  end;

procedure read  (     file         :   in    file_type;
         item         :   out   element_type) is
  begin
      synchronize.read(file,item);
  end;

task body synchronize is
  begin
  select
    accept create (   file         :   in out file_type;
         mode         :   in file_mode    := out_file;
         name         :   string      :=   ;
         form         :   string      :=   )
              do
              sequential_io.create(file,mode,name,form);
              end;

      or
    accept read (     file         :   in    file_type;
    item              :   out   element_type)
          do
          sequential_io.read(file,item);
          end;
      or
      terminate;

end select;

end synchronize;
```

13.6 Elaboration Order

The elaboration order of the library units needed by a main program, is the one specified in ([LRM 83] par. 10.5).

About the matter it must be pointed out that no assumption can be done on the elaboration order of two packages bodies, also when one of them is a with of the other. For instance:

```
package A is
function F return INTEGER;
end A;

package B is
procedure START;
end B;

with A;
package body B is
III: INTEGER:= A.F;
procedure START is
begin
          null;
end START;
end B;
```

In this example the elaboration order can be wrong. In similar cases, the use of the ELABORATE pragma is recommended ([LRM 83], par. 10.5).

13.7 Tasking

It is recommended not to use the PRIORITY pragma in order to accomplish the synchronization among tasks, and to refer to the knowledge of scheduling mechanisms only within the limits of what is specified
in ([LRM 83], par. 9.8).

13.8 I/O Interrupt.

The handling of Mara interrupts coming from interface modules (HIM) must be implemented by using the mechanisms offered by the operating system.

Thus, it is necessary to recall the primitives provided by ([Mara286_2], cap. 11) in order to:

- create a virtual line
- connect the line to a HIM
- suspend an Ada task waiting for the generation of an interrupt coming from that HIM

14 Installation Guide

Purpose of the chapter is to provide Digital VAX/VMS System Manager with an installation procedure for DDC Ada 8086/80286 Compiler System and Alenia Software Components.

The whole Ada installation kit is composed of the following products:

- DACS86 (Ada compiler and Linker)
- ADARTS (Ada run time support)
- ADABIO (Ada BASIC I/O)
- IDA (Cross Debugger)

The installation of these products implies:

- Delivery tape is down loaded
- Mara Factory has already been installed (Kernel, SCL, GENRP...)

14.1 Installation Procedure

The operation preliminary to installation are:

- To login (from system to user)
- To make sure that 30.000 memeory block are available
- To make sure that the logics (such as KER286A0, KER286A1, GATELBA, etc) are correctly assigned;
- To make sure that hosted Intel Software Factory v. 3.2 and following are installed
- To make sure that version /ISIS of INTEL ASM286 and BND286 products are available;
- To create a directory for ADARTS products and associate ADARTSA0 and ADARTSA1 logics name to this area
- to create a directory for ADABIO products and associate ADABIOA0 and ADABIOA1 logic names to this area
- As to IDA installation refer to [IDA286] document
- To create a directory for DACS86 products and associate DACS86A0 logic name to this area

Ada command verb can be chosen as you like provided that the first 4 letters are different from any other DCL command.

Installation procedure requires System Identification Register (SID), obtained through function f$getsyi("sid") and relative check sums supplied by Alenia in a letter enclosed to delivery tape.

Installation command file requires, as input parameter, a file containing information relative to license.

The structure of License Check File (<file>.CKS) is:

<expiration date>
<serial number>
{<sid>
<check sum1>
<check sum2>}

<blank line>
[<compiler name>]

{..} stays for iteration, while [...] stays for optionality. At least one <sid> of a VAX machine must be indicated.

The <compiler name> field indicates the name used to indicate the compiler tool.

The default name is PM286.
The recommanded name is ADA286.
For the installation command see the document "Installation Guide" of the product DACS86.
The installation procedure also executes an ADA program which tests the correcteness of the installation just performed and the correcteness of all tools installed.

To generate the test program an Ada library and a default graph are created.

The result of program generation is a file called HELLO.LTL.

After installation, each user must execute

@DACS86A0:ADAUSE.COM

to have compiler system available for login current session.

14.2 Installation products

The following files are produced when the installation is well terminated:

ADA286.SCL

- ADA286.GRA
- HELLO.LTL

- MULTIi.LTL

The products list follows which must be present in any tape configuration including DACS86.

For a consistent installation, products order in the list is important, too.

1) LICENSE from 00.00

2) SCL286 from 04.0x

3) GENRP from 04.0x

4) KER286 from 04.00

5) ADARTS from 00.00

6) ADABIO from 00.00

7) DACS86 from 04.3x

Note: To run Installation Procedure successfully, System Manager must be sure that Intel Software Factory version v3.2 or subsequent, is installed in VAX/VMS (see [INT]);

15 APPENDIX A [APX A]

15.1 BASIC_IO

```
 Basic_io product
generic
      form : string :=  NODOUBLE_BUFFER  &
 ,LINE_FOLDED  &
 ,NOLINE_EDIT  &
 ,NOSHARE_IN  &
 ,NOSHARE_OUT  &
 ,NOSHARE_INOUT  &
 ,ECHO  &
 ,TERMINATOR  &
 ,TIMED ;
      ci_form : string : =     SHARE_OUT  &
                             ,LINE_EDIT ;
      co_form : string : =     NOTIMED ;
package basic_io is end;
```

15.2 BASIC_IO_CONFIGURATION

```
 Provide for basic_io configuration at program level.
with calendar;
generic
      buffer_size          : integer;
      time_out         : calendar.day_duration;
      number_of_files      : natural;
package basic_io_configuration is end;
```

15.3 DEFAULT_FORM

```
generic
value : string;
package default_form is
end;
```

15.4 DEFAULT_DEVICES

```
generic
input_name     : string;
output_name    : string;
input_form     : string;
output_form    : string;
package default_devices is
end;
```

15.5 ADA_RTS

```
with system;
package ADA_RTS is

 - Tasking support issues


  type computer_id is range 0 .. 15;

  type PSA_REC is
   record
    Unit_no              :system.unsignedword;
    Exception_id         :system.unsignedword;
    Mara_code            :system.unsignedword;
    Exception_offset     :system.unsignedword;
    Exception_selector   :system.segmentid;
   end record;

  function   MY_COMPUTER return computer_id;
  function   SET_CHILD_COMPUTER
            (computer : in computer_id)
      return computer_id;

  function MY_STACK_SIZE return long_integer;

  function SET_CHILD_SEGMENT_SIZE
          (stack_size : in     long_integer)
     return long_integer;

-- Exception support issues

  function EXCEPTION_CODE return system.unsignedword;

-- Set the tracer for unhandled exception
-- as the exception handler of the current function

  procedure unhandled_exception_tracer;

  private

   pragma interface (ASM86, MY_COMPUTER);
   pragma interface_spelling (MY_COMPUTER,"E_Computer")

   pragma interface (ASM86, SET_CHILD_COMPUTER);
   pragma interface_spelling (SET_CHILD_COMPUTER,"E_Child_Computer");
```

```
   pragma interface (ASM86, MY_STACK_SIZE);
   pragma interface_SPELLING (MY_STACK_SIZE,"E_Stack_Size")

   pragma interface (ASM86, SET_CHILD_SEGMENT_SIZE);
                    p      r      a      g      m      a
interface_spelling(SET_CHILD_SEGMENT_SIZE,"E_Child_Segment_Size");

   pragma interface  (ASM86, EXCEPTION_CODE);
   pragma interface_spelling (EXCEPTION_CODE, "E_Error_Code");

   pragma interface  (ASM286, TRACE_INFO);

   pragma interface  (ASM286, GetExceptionId);
    pragma   interface_spelling   (RTS_GetExceptionId,
          "R1EHGE?GetExceptionId");

   pragma interface  (ASM86, RTS_GetExceptionSpelling);
   pragma interface_spelling (RTS_GetExceptionSpelling,
                        "R1EHGE?GetExceptionSpelling")

end ADA_RTS;
```

15.6 REAL_TIME_CLOCK

```
package REAL_TIME_CLOCK is

type TIME is range 0..1000*60*60*24 - 1;  -- ms in a day

procedure SETTIME (TIME_VALUE    : in       TIME);

function GETTIME return TIME;

package TIME_IO is
procedure GET(   item    : out   TIME);
procedure PUT(   item    : in    TIME);
end TIME_IO;

private

pragma INTERFACE(PLM86,SETTIME);
pragma INTERFACE(PLM86,GETTIME);

end REAL_TIME_CLOCK;
```

15.7 BASIC_TYPES

```
package BASIC_TYPES is
```

This package is intended to help Ada programs to be portable respect to the word size of target machines. Programmers should use these types with the explicit size indication and refrain from using INTEGER, NATURAL, POSITIVE and FLOAT standard types.

```
type INTEGER_16 is new INTEGER;                -- for DDC
```

```
type INTEGER_32 is new LONG_INTEGER;      -- for DDC

- type INTEGER_16 is new SHORT_INTEGER;   -- for DEC
- type INTEGER_32 is new INTEGER;         -- for DEC

subtype NATURAL_16 is INTEGER_16 range 0 .. INTEGER_16LAST;
subtype NATURAL_32 is INTEGER_32 range 0 .. INTEGER_32LAST;

subtype POSITIVE_16 is INTEGER_16 range 1 .. INTEGER_16LAST;
subtype POSITIVE_32 is INTEGER_32 range 1 .. INTEGER_32LAST;

type FLOAT_32 is new FLOAT;                   -- For DDC and DEC
type FLOAT_64 is new LONG_FLOAT;          -- For DDC and DEC

end BASIC_TYPES;
```

15.8 ADDRESS_IMAGE

```
- 21_FEB_1989 12:21:00.77    /MARTIN
with SYSTEM;       use SYSTEM;
with UNCHECKED_CONVERSION;
with BASIC_TYPES; use BASIC:TYPES;
function ADDRESS_IMAGE ( V : in ADDRESS )
return STRING is

- This function is suitable for VAX targets with DEC or DDC Ada

function CONV is new UNCHECKED_CONVERSION
  (SOURCE => ADDRESS,
   TARGET => INTEGER_32 );

begin

return INTEGER_32' IMAGE ( CONV( V ) );

end ADDRESS_IMAGE;
```

15.9 CALENDAR_IMAGE

```
with CALENDAR; use CALENDAR;
package CALENDAR_IMAGE is

function DATE_IMAGE( T : in TIME ) return STRING;

function DATE_IMAGE return STRING;

function TIME_IMAGE( T : in TIME ) return STRING;

function TIME_IMAGE return STRING;

end CALENDAR_IMAGE;
```

15.10 GENERIC_DUMPS

```
-   1-DEC-1988 16:15:09.22   /MARTIN
with TEXT_IO;                 use TEXT_IO;
with CALENDAR;                use CALENDAR;
with BASIC_TYPES;        use BASIC_TYPES;
package GENERIC_DUMPS is

type BOX is (UNBOXED, BOXED);

DUMP_FILE : FILE_TYPE;

The following procedures must be called at the start and at the end
of a test run.

procedure START_RUN( UNIT_NAME : in  STRING );

procedure END_RUN;


The following procedure allows labelling the start of the dump output
relative to a certain test. These labels can be used to facilitate
correlation between a program and the dump output it produced or
comparison between the dumps produced in different executions.

procedure START-TEST  ( TEST_NUMBER : in POSITIVE_16;
                        DESCRIPTION : in STRING :=    );


The following procedures help the user to generate dump procedures for
his own record types.

procedure START_ARRAY     ( NAME : in STRING; B : in BOX );

procedure START_RECORD    ( NAME : in STRING; B : in BOX );

procedure END_ARRAY   ( B: in BOX);

procedure END_RECORD  ( B : in BOX);


Basic procedure for dumping string literals

procedure DUMP    ( S : in STRING;
                    B : in BOX := UNBOXED );


Basic procedure for dumping objects of type STRING

procedure DUMP    ( NAME : in STRING;
                    V    : in STRING;
                    B    : in BOX := UNBOXED );

Procedure for dumping objects of type CALENDAR.TIME
```

```
procedure DUMP    ( NAME : in STRING;
                    V    : in CALENDAR.TIME;
                    B    : in BOX := UNBOXED );
```

The following generics enable the user to generate dump procedures for his own simple types and array types.

```
generic
type DISCRETE_TYPE is (<>);
procedure DISCRETE_DUMP       ( NAME : in STRING;
                                V    : in DISCRETE_TYPE;
                                B    : in BOX := UNBOXED );

generic
type FIXED_TYPE is delta <>;
procedure FIXED_DUMP      ( NAME : in STRING;
                            V    : in FIXED_TYPE;
                            B    : in BOX := UNBOXED );

generic
type FLOAT_TYPE is digits <>;
procedure FLOAT_DUMP      ( NAME : in STRING;
                            V    : in FLOAT_TYPE;
                            B    : in BOX := UNBOXED );

generic
type ACCESS_TYPE is private;
procedure ACCESS_DUMP         ( NAME : in STRING;
    V    : in ACCESS_TYPE;
    B    : in BOX := UNBOXED );

generic
type INDEX_TYPE is (<>);
type COMPONENT_TYPE is private;
type ARRAY_TYPE is array(INDEX_TYPE ) of COMPONENT_TYPE;
with procedure DUMP       ( NAME : in STRING;
    V    : in COMPONENT_TYPE;
    B    : in BOX := UNBOXED ) is <>;
procedure ARRAY_DUMP          ( NAME : in STRING;
    V    : in ARRAY_TYPE;
    B    : in BOX := UNBOXED );

generic
type INDEX1_TYPE is (<>);
type INDEX2_TYPE is (<>);
tpe COMPONENT_type is private;
type ARRAY_TYPE is array( INDEX1_TYPE, INDEX2_TYPE )
of COMPONENT_TYPE;
with procedure DUMP       ( NAME : in STRING;
    V    : in COMPONENT_TYPE;
    B    : in BOX := UNBOXED ) is <>;
procedure ARRAY2_DUMP         ( NAME : in STRING;
    V    : in ARRAY_TYPE;
    B    : in BOX := UNBOXED );
end GENERIC_DUMPS;
```

15.11 BASIC_DUMPS

```
-   1-DEC-1988 16:17:04.65   /MARTIN
with BASIC_TYPES;   use BASIC_TYPES;
with GENERIC_DUMPS  use GENERIC_DUMPS;
package BASIC_DUMPS is

These are instantiations, for the predefined types and the types
defined in package BASIC_TYPES, of the generic dumping procedures in
GENERIC_DUMPS.

procedure DUMP is new DISCRETE_DUMP
( DISCRETE_TYPE => INTEGER_16 );
procedure DUMP is new DISCRETE_DUMP
( DISCRETE_TYPE => INTEGER_32 );

procedure DUMP is new DISCRETE_DUMP
( DISCRETE_TYPE => BOOLEAN );

procedure DUMP is new DISCRETE_DUMP
( DISCRETE_TYPE => CHARACTER );

procedure DUMP is new FIXED_DUMP
( FIXED_TYPE => DURATION );

procedure DUMP is new FLOAT_DUMP
( FLOAT_TYPE => FLOAT_32 );

procedure DUMP is new FLOAT_DUMP
( FLOAT_TYPE => FLOAT_64 );

end BASIC_DUMPS;
```

15.12 RANDOM

```
-  27-FEB-1989 08:32:13.50   /MARTIN
with BASIC_TYPES; use BASIC_TYPES;
package RANDOM is

The algorithm is taken from the article:
 Random number generators: good ones are hard to find
S.K. Park  and  K.W. Miller
Communications of the ACM, Oct 1988, Vol 31, Number 10.

The user may set SEED to any NATURAL_32 value

SEED : NATURAL_32 := 1;

function RAND return NATURAL_32;    -- 0 .. 2,147,483,647
function RAND return FLOAT_32;      -- 0.0 .. 1.0
```

```
function RAND return INTEGER_16;  -- 32768 .. 32767

end RANDOM;
```

15.13 DUMP 287

- Alenia
- Informatics Factory
- August 1989

Procedure to dump 287 stack top trace buffer contents. The procedure is for use in debugging of coprocessor algorithms written in ASM286. In particular it is used for the debugging of the math library MATHLIB .

```
with GENERIC_DUMPS; use GENERIC_DUMPS;
procedure DUMP287 ( B : in BOX := UNBOXED ) is

   type REF_LABEL is access INTEGER_16;

   function GET_NREC return NATURAL_16;
   pragma INTERFACE (PLM_NOAC,GET_NREC);
   pragma INTERFACE_SPELLING ( GET_NREC, "mathlib_GET_NREC" );

   function GET_SAVED_LABEL ( N: in POSITIVE_16) return REF_LABEL;
   pragma   INTERFACE ( PLM_NOACF, GET_SAVED_LABEL );
   pragma   INTERFACE ( GET_SAVED_LABEL, "mathlib_GET_SAVED_LABEL");

   function GET_SAVED_ST ( N: in POSITIVE_16) return FLOAT_64;
   pragma   INTERFACE ( PLM_NOACF, GET_SAVED_ST );
   pragma   INTERFACE ( GET_SAVED_LABEL, "mathlib_GET_SAVED_ST");

   procedure DUMP is new ACCESS_DUMP( REF_LABEL );

   NREC: NATURAL_16;

   begin

   NREC := GET_NREC;
   START_ARRAY ( "287/387 STACK TOP TRACES", 8);
   for I in 1..NREC loop
       START_RECORD ("TRACE_RECORD", UNBOXED);
       DUMP( "TRACE_LABEL", GET_SAVED_LABEL(I));
       DUMP( "ST_VALUE", GET_SAVED_ST(I));
   end loop;
   END_ARRAY(b);

 END DUMP287;
```

15.14 MATH_LIB

```
- Alenia
- Informatics Factory
- August 1989

--This file contains the specifications of packages MATH_LIB_32
--and MATHLIB_64 for use on Mara286 with MON286, MUL286, or MUL386
--boards with or without their respective coprocessor chips.
--The body is contained in an ASM286 module called MATHLIB.

with BASIC_TYPES; use BASIC_TYPES;
package MATH_LIB_32 is

function SQRT          ( X : in FLOAT_32 )          return FLOAT_32;
function LOG           ( X : in FLOAT_32 )          return FLOAT_32;
function LOG10         ( X : in FLOAT_32 )          return FLOAT_32;
function EXP           ( X : in FLOAT_32 )          return FLOAT_32;
function Y2X           ( Y, X : in FLOAT_32 )       return FLOAT_32;
function Y2I           ( Y : in FLOAT_32;
                   I   : in INTEGER_16 )        return FLOAT_32;
function SIN           ( X : in FLOAT_32 )          return FLOAT_32;
function COS           ( X : in FLOAT_32 )          return FLOAT_32;
function TAN           ( X : in FLOAT_32 )          return FLOAT_32;
function SIN_SC        ( X : in FLOAT_32 )          return FLOAT_32;
function COS_SC                                     return FLOAT_32;
function ATAN2         ( Y, X : in FLOAT_32 )       return FLOAT_32;
function ATAN          ( Y : in FLOAT_32 )          return FLOAT_32;
function ASIN          ( X : in FLOAT_32 )          return FLOAT_32;
function ACOS          ( X : in FLOAT_32 )          return FLOAT_32;
function SINH          ( X : in FLOAT_32 )          return FLOAT_32;
function COSH          ( X : in FLOAT_32 )          return FLOAT_32;
function TANH          ( X : in FLOAT_32 )          return FLOAT_32;

--Out of range arguments cause exception NUMERIC_ERROR to be raised.

private

pragma INTERFACE( C_REVERSE_NOACF, SQRT );
pragma INTERFACE_SPELLING( LOG,"mathlib_SQRT");

pragma INTERFACE( C_REVERSE_NOACF, LOG );
pragma INTERFACE_SPELLING( LOG,"mathlib_LOG");

pragma INTERFACE( C_REVERSE_NOACF, LOG10 );
pragma INTERFACE_SPELLING( LOG10,"mathlib_LOG10" );

pragma INTERFACE( C_REVERSE_NOACF, EXP );
pragma INTERFACE_SPELLING( EXP,"mathlib_EXP" );

pragma INTERFACE( C_REVERSE_NOACF, Y2X );
pragma INTERFACE_SPELLING( Y2X, "mathlib_Y2X" );

pragma INTERFACE( C_REVERSE_NOACF, Y2I );
pragma INTERFACE_SPELLING( Y2I,"mathlib_Y2I" );

pragma INTERFACE( C_REVERSE_NOACF, SIN );
pragma INTERFACE_SPELLING( SIN,"mathlib_SIN" );
```

```
pragma INTERFACE( C_REVERSE_NOACF, COS );
pragma INTERFACE_SPELLING( COS, "mathlib_COS" );

pragma INTERFACE( C_REVERSE_NOACF, TAN );
pragma INTERFACE_SPELLING( TAN, "mathlib_TAN" );

pragma INTERFACE( C_REVERSE_NOACF, COS_SC );
pragma INTERFACE_SPELLING( COS_SC, "mathlib_COS_SC" );

pragma INTERFACE( C_REVERSE_NOACF, ASIN );
pragma INTERFACE_SPELLING( ASIN, "mathlib_ASIN ");

pragma INTERFACE( C_REVERSE_NOACF, ACOS );
pragma INTERFACE_SPELLING( ACOS, "mathlib_ACOS" );

pragma INTERFACE( C_REVERSE_NOACF, ATAN );
pragma INTERFACE_SPELLING( ATAN, "mathlib_ATAN" );

pragma INTERFACE( C_REVERSE_NOACF, ATAN2 );
pragma INTERFACE_SPELLING( ATAN2, "mathlib_ATAN2"  );

pragma INTERFACE( C_REVERSE_NOACF, SINH );
pragma INTERFACE_SPELLING( SINH, "mathlib_SINH" );

pragma INTERFACE( C_REVERSE_NOACF, COSH );
pragma INTERFACE_SPELLING( COSH, "mathlib_COSH" );

pragma INTERFACE( C_REVERSE_NOACF, TANH );
pragma INTERFACE_SPELLING( TANH, "mathlib_TANH" );

end MATH_LIB_32;



- Alenia
- Informatics Factory
- August 1989

This file contains the specification of package MATH_LIB_64 for use
on Mara286 with the Intel CEL287 library.

with BASIC_TYPES; use BASIC_TYPES;
package MATH_LIB_64 is

function SQRT         ( X : in FLOAT_64 )         return FLOAT_64;
function LOG          ( X : in FLOAT_64 )         return FLOAT_64;
function LOG10        ( X : in FLOAT_64 )         return FLOAT_64;
function EXP          ( X : in FLOAT_64 )         return FLOAT_64;
function Y2X          ( Y, X : in FLOAT_64 )      return FLOAT_64;
function Y2I          ( Y : in FLOAT_64;
                      I : in INTEGER_16 )         return FLOAT_64;
function SIN          ( X : in FLOAT_64 )         return FLOAT_64;
function COS          ( X : in FLOAT_64 )         return FLOAT_64;
function TAN          ( X : in FLOAT_64 )         return FLOAT_64;
function SIN_SC       ( X : in FLOAT_64 )         return FLOAT_64;
function COS_SC                                   return FLOAT_64;
```

```
function ATAN2        ( Y, X : in FLOAT_64 )      return FLOAT_64;
function ATAN         ( Y : in FLOAT_64 )         return FLOAT_64;
function ASIN         ( X : in FLOAT_64 )         return FLOAT_64;
function ACOS         ( X : in FLOAT_64 )         return FLOAT_64;
function SINH         ( X : in FLOAT_64 )         return FLOAT_64;
function COSH         ( X : in FLOAT_64 )         return FLOAT_64;
function TANH         ( X : in FLOAT_64 )         return FLOAT_64;
```

Out of range arguments cause exception NUMERIC_ERROR to be raised.

private

The use of the language C_REVERSE_NOACF in the following INTERFACE pragmas is to work around a bug in the code generator. This bug has been fixed in a version not yet released.

```
pragma INTERFACE(C_REVERSE_NOACF, SQRT);
pragma INTERFACE_SPELLING(SQRT, "mathlib_SQRT");

pragma INTERFACE( C_REVERSE_NOACF, LOG );
pragma INTERFACE_SPELLING( LOG,"mathlib_LOG" );

pragma INTERFACE( C_REVERSE_NOACF, LOG10 );
pragma INTERFACE_SPELLING( LOG10, " mathlib_log10"  );

pragma INTERFACE( C_REVERSE_NOACF, EXP );
pragma INTERFACE_SPELLING( EXP, "mathlib_EXP" );

pragma INTERFACE( C_REVERSE_NOACF, Y2X );
pragma INTERFACE_SPELLING( Y2X, "mathlib_Y2X ");

pragma INTERFACE( C_REVERSE_NOACF, Y2I );
pragma INTERFACE_SPELLING( Y2I,  "mathlib_Y2I"  );

pragma INTERFACE C_REVERSE_NOACF, SIN );
pragma INTERFACE_SPELLING( SIN,  "mathlib_SIN " );

pragma INTERFACE( C_REVERSE_NOACF, COS );
pragma INTERFACE_SPELLING( COS,  "mathlib_COS" );

pragma INTERFACE( C_REVERSE_NOACF, TAN );
pragma INTERFACE_SPELLING( TAN, "mathlib_TAN" );

pragma INTERFACE( C_REVERSE_NOACF, COS_SC );
pragma INTERFACE_SPELLING( COS_SC,  "mathlib_COS_SC"  );

pragma INTERFACE( C_REVERSE_NOACF, SIN_SC );
pragma INTERFACE_SPELLING( SIN_SC,  "mathlib_SIN_SC"  );

pragma INTERFACE( C_REVERSE_NOACF, ASIN );
pragma INTERFACE_SPELLING( ASIN, " mathlib_ASIN"  );

pragma INTERFACE( C_REVERSE_NOACF, ACOS );
pragma INTERFACE_SPELLING( ACOS,  "mathlib_ACOS"  );

pragma INTERFACE( C_REVERSE_NOACF, ATAN );
```

```
pragma INTERFACE_SPELLING( ATAN, " mathlib_ATAN"  );

pragma INTERFACE( C_REVERSE_NOACF, ATAN2 );
pragma INTERFACE_SPELLING( ATAN2, " mathlib_ATAN2"  );

pragma INTERFACE( C_REVERSE_NOACF, SINH );
pragma INTERFACE_SPELLING( SINH,"  mathlib_SINH " );

pragma INTERFACE( C_REVERSE_NOACF, COSH );
pragma INTERFACE_SPELLING( COSH, " mathlib_COSH " );

pragma INTERFACE( C_REVERSE_NOACF, TANH );
pragma INTERFACE_SPELLING( TANH, " mathlib_TANH"  );

end MATH_LIB_64;
```

16 APPENDIX B [APX B]

16.1 ADA286.GRA

```
system  ADA286;

program template ADA286 large
code  PRIVATE
data  PRIVATE  NODAL;
module    :FMS:ADARTSA1/RTSDATA.OBJ        relocatable;
module    :FMS:ADABIOA1/BIODATA.OBJ        relocatable;
module    ADA286                           relocatable;
module    :FMS:DACS86A0/ROOT.LIB           relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB      relocatable;
module    :FMS:KER286A0/ADAUS.LIB          relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB      relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB      relocatable;
module    :FMS:KER286A0/ADAUS.LIB          relocatable;
module    GATELBA                          relocatable;

initial procedure cg_adamainprogram
stacksegment size = 0FF00H;

end program;
$ eject

program template MULTI_ADA286 large
code PRIVATE
data PRIVATE NODAL;

subprogram GENERAL repeatable;
module    :FMS:ADARTSA1/RTSDATA.OBJ       relocatable;
module    :FMS:ADABIOA1/BIODATA.OBJ       relocatable;
module    ELABORATION source asm;
$include(Repeated)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
```

```
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_0 optonal;
$include(Zone0)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_1 optional;
$include(Zone1)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_2 optional;
$include(Zone2)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_3 optional;
$include(Zone3)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_4 optional;
$include(Zone4)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
```

```
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_5 optional;
$include(Zone5)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_6 optional;
$include(Zone6)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_7 optional;
$include(Zone7)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_8 optional;
$include(Zone8)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    GATELBA                                relocatable;
end subprogram;

subprogram ZONE_9 optional;
$include(Zone9)
module    :FMS:DACS86A0/ROOT.LIB             relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB        relocatable;
module    :FMS:KER286A0/ADAUS.LIB            relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB    relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB    relocatable;
```

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module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module    GATELBA                                   relocatable;
end subprogram;

subprogram ZONE_10 optional;
$include(Zone10)
module     :FMS:DACS86A0/ROOT.LIB               relocatable;
module     :FMS:DACS86A0/RTHELP286.LIB          relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module     :FMS:ADABIOA1/BINDER286.LIB      relocatable;
module     :FMS:ADARTSA1/BINDER286.LIB      relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module   GATELBA                                    relocatable;
end subprogram;

subprogram ZONE_11 optional;
$include(Zone11)
module     :FMS:DACS86A0/ROOT.LIB          relocatable;
module     :FMS:DASCS86A0/RTHELP286.LIB    relocatable;
module     :FMS:KER286A0/ADAUS.LIB         relocatable;
module     :FMS:ADABIOA1/BINDER286.LIB      relocatable;
module     :FMS:ADARTSA1/BINDER286.LIB      relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module    GATELBA                                   relocatable;
end subprogram;

subprogram ZONE_12 optional;
$include(Zone12)
module     :FMS:DACS86A0/ROOT.LIB               relocatable;
module     :FMS:DACS86A0/RTHELP286.LIB          relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module     :FMS:ADABIOA1/BINDER286.LIB      relocatable;
module     :FMS:ADARTSA1/BINDER286.LIB      relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module   GATELBA                                    relocatable;
end subprogram;

subprogram ZONE_13 optional;
$include(Zone13)
module     :FMS:DACS86A0/ROOT.LIB               relocatable;
module     :FMS:DACS86A0/RTHELP286.LIB          relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module     :FMS:ADABIOA1/BINDER286.LIB      relocatable;
module     :FMS:ADARTSA1/BINDER26.LIB       relocatable;
module     :FMS:KER286A0/ADAUS.LIB          relocatable;
module    GATELBA
end subprogram;

subprogram ZONE_14 optional;
$include(Zone14)
module     :FMS:DACS86A0/ROOT.LIB               relocatable;
module     :FMS:DACS86A0/RTHELP286.LIB          relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
module     :FMS:ADABIOA1/BINDER286.LIB      relocatable;
module     :FMS:ADARTSA1/BINDER286.LIB      relocatable;
module     :FMS:KER286A0/ADAUS.LIB              relocatable;
```

```
module    GATELBA                                    relocatable;
end subprogram;

subprogram ZONE_15 optional;
$include(Zone15)
module    :FMS:DACS86A0/ROOT.LIB          relocatable;
module    :FMS:DACS86A0/RTHELP286.LIB     relocatable;
module    :FMS:KER286A0/ADAUS.LIB         relocatable;
module    :FMS:ADABIOA1/BINDER286.LIB     relocatable;
module    :FMS:ADARTSA1/BINDER286.LIB     relocatable;
module    :FMS:KER286A0/ADAUS.LIB         relocatable;
module    GATELBA                         relocatable;
end subprogram;

initial procedure cg_adamainprogram
stacksegment nodal size = 0ff00h;

end program;

hardware configuration;

volume DEFAULT_VOLUME,
presence NODAL origin FIRST_NODAL_PAGE,
LOCAL to  0 origin FIRST_LOCAL_PAGE,
LOCAL to  1 origin FIRST_LOCAL_PAGE,
LOCAL to  2 origin FIRST_LOCAL_PAGE,
LOCAL to  3 origin FIRST_LOCAL_PAGE,
LOCAL to  4 origin FIRST_LOCAL_PAGE,
LOCAL to  5 origin FIRST_LOCAL_PAGE,
LOCAL to  6 origin FIRST_LOCAL_PAGE,
LOCAL to  7 origin FIRST_LOCAL_PAGE,
LOCAL to  8 origin FIRST_LOCAL_PAGE,
LOCAL to  9 origin FIRST_LOCAL_PAGE,
LOCAL to 10 origin FIRST_LOCAL_PAGE,
LOCAL to 11 origin FIRST_LOCAL_PAGE,
LOCAL to 12 origin FIRST_LOCAL_PAGE,
LOCAL to 13 origin FIRST_LOCAL_PAGE,
LOCAL to 14 origin FIRST_LOCAL_PAGE,
LOCAL to 15 origin FIRST_LOCAL_PAGE;
end configuration;

include ADA286 local to 0;
initial process on 0 priority 2;

include MULTI_ADA286;
$include(SubprogramAssign)
initial process on 0 priority 2;

end system;
```

16.2 REFERENCES

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[MATH]	Mathematics Library for Ada on Mara User Manual rev 1.0
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[ADAMAP]	ADA MAPPER User Guide
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[SEL1 87]	MARA-286 An Overiew of the Software Factory September 1987
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[Alenia Software Products]	Basic Softare Delivery Document
[MARA286_1 87]	MARA286 Computer Monograph - Volume 1
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[MARA286_4 87] MARA286 Computer Monograph - Volume 4